Vol. 11 MAY, 1928 No. 5

# Journal

of the

# American Ceramic Society

Abstracts Bulletin

A Monthly *Journal* Devoted to the Arts and Sciences
Related to the Silicate Industries

*Publication Office:* 450 Ahnaip St., Menasha, Wis.

*Editorial and Advertising Offices:* 2525 N. High St., Columbus, Ohio.

*Executive Office:* 2525 N. High St., Columbus, Ohio.

*Committee on Publications:* F. K. Pence, *Chairman;* W. E. Dornbach, F. C. Flint, M. L. Hartmann, Ross C. Purdy.

Entered as second class matter at the post office at Menasha, Wis. Acceptance for mailing at special rate of postage provided for in the Act of February 28, 1925, embodied in paragraph 4, section 412, P. L. and R. authorized January 29, 1926.

*(Copyright 1928, American Ceramic Society)*

Twelve dollars a year. Single numbers, one dollar. *(Foreign postage, 50c additional)*

## An Important Factor In the Appeal of

The artistic and sales possibilities of Color are definitely increased by a careful selection of materials.

R & H has long been a dependable source of supply. Most materials essential to production are available from us, each representing unexcelled quality.

Helpful counsel may also be obtained from R & H. For forty-five years we have served the ceramic industries through the development of better aids to manufacturing. And our technical men place their comprehensive experience for the application of our materials at your disposal.

These R & H products may be used with profit—

Chemicals for coloring glazes and glass.

Metallic Oxides for colored enamels.

Vitrifiable colors for glass and china decoration.

Overglaze colors for art pottery and enamels.

Gold and Lusters for glass, china and enamelware decoration.

*The*
**ROESSLER & HASSLACHER CHEMICAL CO.**
709 Sixth Avenue New York, N. Y.

"AMERICA'S LEADING CERAMIC MATERIAL HOUSE"

FREEDOM from the bother of constant adjustments . . . from the strained watchfulness of maintaining even temperatures . . . this is the freedom that strengthens morale.

Freedom from worry—uncertainty—instilled by perfect CONFIDENCE in a never-failing automatic heat control.

The L & N Automatic Temperature Control strengthens morale—*makes your men worth more.*

In L & N Potentiometer Controllers and Recorders the tiny current set up in the thermocouple is not measured, but its voltage is opposed and balanced repeatedly, automatically, by a known voltage. As each balance is made, a continuously accurate temperature reading is taken, *a reading that gives your men confidence.*

Resistance variables are eliminated, for no current flows. Galvanometer inaccuracies are gone, for the galvanometer is not even calibrated.

*Confidence* is instilled because these features make L & N Potentiometer Pyrometers more accurate and reliable.

Write for Catalog No. 87-K, "Potentiometer Pyrometers," or Catalog 84-K, "Potentiometers For Automatic Temperature Control."

LEEDS & NORTHRUP COMPANY
ELECTRICAL MEASURING INSTRUMENTS
PHILADELPHIA, PA.

BRANCH OFFICES: CLEVELAND, CHICAGO, HOUSTON, LOS ANGELES, SAN FRANCISCO

*The* "Different from all others"

**Potentiometer**

***most accurate • • PYROMETER • • in industry***

P-59 A

*(When writing to advertisers, please mention the JOURNAL)*

# "And do *you* like *your* job?" *he shot at me*

*(Incidents That Have Pointed the Way—No. 5 of a Series.)*

WHEN men like their jobs it is no secret to their families and to the community in which they live. The following incident came as a personal experience to an officer and director of The American Rolling Mill Company. In telling it he said:

"A few days ago I was walking to the office when I came across a bright little chap with books under his arm. If you have never had the pleasure of walking to school with one of these little chaps on some clear, crisp morning, you have missed something. As our ways lay in the same direction, I caught step with him as he cheerily answered my 'Good morning.'

"'Going to school?' I asked.

"'Yes,' he said, as he measured his sturdy limbs to my stride.

"'You like school?' was my next query.

"'Sure thing!' he said, and his laugh had all the ring of youth.

"'Where does your father work?' I boldly asked.

"'He works for The Rolling Mill, and I'm going to work for The Rolling Mill too, when I grow up,' was the immediate response.

"'Does your daddy like his job?' I inquired, trusting youth to give the answer without guile or flattery.

"'Sure, he likes his job,' came the answer.

"Then the lad looked me squarely in the eyes and asked: 'Where do you work?'

"It had come my turn to be catechized, and so I stated that I, too, worked for The Rolling Mill.

"'And do *you* like *your* job?' he shot at me.

"With this the tables were turned. It was now up to me. I had to make good with this little chap of nine years and tell him of my enthusiasm for Armco and all it stands for. And *believe me,* I did.

"Nothing in my life has ever inspired me more than this little encounter with the schoolboy. In the sunlight of his radiant countenance the little chap revealed a phase of industrial progress too often overlooked—the far-reaching influence of the happy, contented worker's home."

Great smokestacks, gigantic machinery, colossal holdings do not, alone, make up the realm of industry. Out of the home incentive come the great contributions to industry. Such is the influence behind the men of Armco who more than twenty years ago took up the task of producing a commercially pure iron.

## *Ideal for Vitreous Enameling*

Enamelers everywhere find in ARMCO Ingot Iron the solution to many vexatious problems. Being pure, uniform and virtually degasified, it reduces cull losses, thereby increasing plant profits. Moreover, ARMCO Ingot Iron has a velvety-textured surface which grips and holds enamel. From the ground coat to the finished job it consistently produces *results.*

ARMCO Ingot Iron

*Write for a copy of "ARMCO Ingot Iron—Its Development and Service"*

**The American Rolling Mill Co.**
**Executive Offices, Middletown, Ohio**

Export: The ARMCO International Corp.
Cable Address—ARMCO, Middletown, Ohio

*What You Gain with the*

# CARBO-RADIANT DIRECT FIRED KILN–

One of the seven Carbo-Radiant Kilns in operation at the Fords Porcelain Works Perth Amboy, N. J.

THIS is a new type of much interest to the Ceramic industry—a direct fired kiln, burning oil, producing glazed ware formerly burned in muffle kilns.

¶The necessary control of kiln atmosphere and temperature is obtained by the use of Carborundum Carbo-Radiant Combustion Chambers.

¶No muffle is used. This reduces the fuel consumption by approximately 40 per cent.

¶This direct firing method eliminates the lag in heating and cooling which occurs when muffles are used thus giving a quicker kiln turnover.

¶This kiln is operated with two or four oil burners instead of the usual eight to fourteen.

¶The costly maintenance of muffles and fireboxes is eliminated, as well as loss of production due to shutdowns.

¶Simplicity of heat control—economy of operation—a clean kiln atmosphere and a reduction of spoiled ware is assured with the use of this kiln.

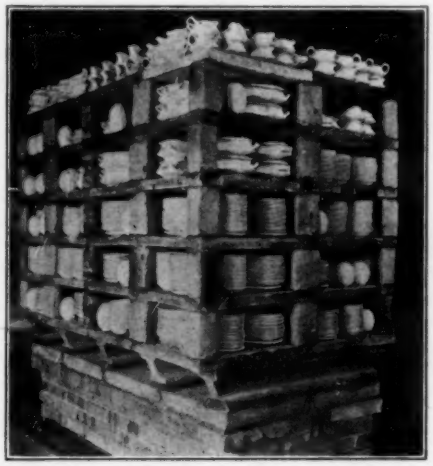
¶The kiln being rectangular is easy to load and unload. It gives the maximum kiln capacity for the floor space occupied.

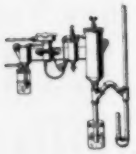
¶Since burners are located at front and rear, these kilns may be built in battery with no waste space between kilns.

*The Carbo-Radiant Direct Fired Kilns are designed and built by The Carborundum Company, Perth Amboy, N. J.*

**THE CARBORUNDUM COMPANY, PERTH AMBOY, N. J.**

Reg. U. S. Pat. Off.





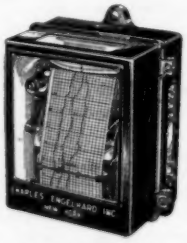
$CO_2$ Analyzer works electrically on the thermal conductivity principle. Protection of the active heating elements from vibration and corrosive gases, and thorough drying and filtering of the gas before analysis insure enduring accuracy.

# Maintain Color Uniformity with *Engelhard $CO_2$ Recording Analyzers*

**The increasing tendency toward color in porcelains, tiles, terra cotta, enamels, and other ceramic products makes control of kiln atmosphere imperative to avoid spoilage and to obtain uniformity of product.**

"To obtain uniformity of texture of the colored enamels . . . it was found desirable to (*a*) accurately duplicate time and temperature of calcination, and in some cases furnace atmospheres."—Harrison and Hartshorn, "A Preliminary Study of Ceramic Colors, etc." *Jnl. Am. Cer. Soc.*, Oct., 1927.

Engelhard $CO_2$ Analyzer will enable you to maintain uniformity of product at reduced costs. With these instruments you can supply your operators with charts as guides in holding reducing or oxidizing atmospheres for given periods of time.




*Type S Recorder*

Engelhard Type S Recorder makes a continuous graphic chart of the Analyzer readings that is easy to read or to cut and file. It can make 1 to 6 different records at once of gas analyses, or temperatures, or both, in black or colors.

Consult our Ceramic Engineering Department about your plant problems. Many ceramic manufacturers have found this free service invaluable.

## CHARLES ENGELHARD, INC.

**90 Chestnut Street, Newark, N. J.**

A. M. Meincke, Inc.
Hammill & Gillespie, Inc.
The John W. Higman Company
John Richardson Company
English China Clays Sales Corp.
Paper Makers Importing Company, Inc.
Moore & Munger

*Extend to the members of the* European Ceramic Tour *a hearty invitation to visit*

# CORNWALL

*The Home of China Clay*

Your visit will be
Interesting
Educational and
Pleasurable

*Special Reception and Entertainment Awaits*

YOU!

# GAS

## costs less to use

THE cost of crude fuel goes far beyond its original purchase price. Unloading, storage, ash removal, spoilage, insurance, tied-up capital — all represent extra costs you can't overlook.

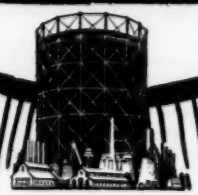
When you use gas you eliminate these extra and sizable charges — out go the scavengers of waste and spoilage.

You have a fuel that affords you the most modernized type of fuel service. It is delivered to your burners in any desired quantity instantly — its uniform quality and ease of control bring efficiency to your operations and profit to your ledgers.

Get the facts about gas. Your local gas company can tell you, or write to

American Gas Association
420 Lexington Avenue, New York City

**YOU CAN DO IT BETTER WITH GAS**



FISHER

# Combination Air Reducing Valves

## *pay for themselves in air savings*

More than half of all the air machines and processes are, today, being fed at pressures of 20 per cent and more IN EXCESS of their actual need. This waste increases cost—power—sand, etc. Put a Fisher Type-78 in your line—reduce your feed pressure—and you'll do better work at a lower cost per operation.

The Fisher Type-78 Air Reducing Valve is sturdy and lasting—ONE SIMPLE ADJUSTMENT. Suitable for 200 lb. initial and 5 to 75 lb. reduced pressure. Built in 1", 1¼", 1½", 2" sizes and furnished complete. We'll be glad to send you full specifications.

## The Fisher Governer Co., Inc.

**100 Fisher Bldg.** **Marshalltown, Iowa**

# CHAMPION

## SILLIMANITE PROTECTING TUBES

***Insure longer life from your rare metal thermocouples***

**Made from Champion Spark Plug Sillimanite these protecting tubes form a strong, dependable barrier against contaminating gases and mechanical strains. Below are listed a few of the many advantages to be gained by their use.**

Highest melting point: 2000 to 1800 C. The bending temperature is therefore correspondingly high.

Extreme refractoriness: Tremendously resistant to fusion and free from expansion and contraction strains.

Permanently impervious to gases: Vitrified throughout each wire permanently free from harmful gases.

Famous for insulating qualities: High insulating qualities at all temperatures, vital to thermocouple use.

Mechanically strong: Surprisingly resistant to injury by mechanical shocks and other external strains.

Homogeneous, uniformly sound: Manufacturing processes assure uniform homogeneity of composition and structure.

Unharmed by corrosive gases and chemicals. Wont deteriorate in contact with furnace gases at high temperature.

Absolutely standardized: Repeat orders can be placed with confidence in the consistent quality of these tubes.

COVERED BY PATENTS AND PATENTS PENDING

*Write for Pyrometer Catalog No. 15 describing Sillimanite Protecting Tubes; address, The Brown Instrument Company, 4447 Wayne Ave., Philadelph:., Pa. Branches in 20 principal cities.*

**Brown Pyrometers**

# Table of Contents

MAY, 1928

## The Journal

Methods for Testing Crazing of Glazes Caused by Increases in Size of Ceramic Bodies—Schurecht ..... 271
The Prevention of Disintegration of Blast Furnace Linings—Mitra and Silverman ..... 278
Some Effects of Carefully Annealing Optical Glass—Tilton, Finn, and Tool ..... 292
Some Factors Influencing the Thermal Properties of Minerals and Products of the Ceramic Industry—Cohn ..... 296
Acid-Resisting Overglaze Colors—Tailby ..... 307
Brick Machine, Bucket Elevator, and Hammer Mill Power Determinations—Ogden ..... 310
A Study of the Calcium-Sodium Ratio of Certain Waters—Hart ..... 314
Plasticity of Clay—Jenks ..... 317
Use of the Simulative Test Furnace as a Means of Making Comparative Tests of Fire Brick—Rogers ..... 323
Notes on Potassium Bisulphate Fusions—Kerr ..... 330

## Ceramic Abstracts

267

## The Bulletin

**Editorials**

Society Consciousness ..... 119
Ceramic Library and Museum ..... 120

**Papers and Discussions**

Practical Aids to Wet Process Cast-Iron Enameling—Hansen ..... 122
Discussion on "Acid-Resistant Enamels"—Musiol ..... 127
Bibliography of Plasticity—Slegel ..... 130

**Activities of the Society**

Additional Program for Ceramists' Tour Abroad ..... 137
New Members Received from March 1 to April 1 ..... 144
Membership Workers' Record ..... 145
Personal News from Members of the Society ..... 145
Enamel Bibliography in Preparation ..... 145

**Local Section News**

Pittsburgh Section to Meet with A.S.M.E. May 14-17 ..... 146
April Meeting of Pittsburgh Section ..... 147
Baltimore-Washington Section ..... 147
California Section ..... 147
By-Laws of California Section AMERICAN CERAMIC SOCIETY ..... 148

**Notes and News**

W. E. Wells for Director U.S. Chamber of Commerce ..... 149
An Earned Tribute to Charles Lucius Allen, President of Norton Co. ..... 150
Obituaries ..... 152
W. F. Demuth ..... 152
Charles W. Brown ..... 153
W. A. B. Dalzell ..... 154
William Cameron Sproul ..... 154
Arthur L. Davidson ..... 154
William Gardner ..... 154
Views of Ceramic Work at the University of Oklahoma ..... 154
Toronto Ceramic Students Entertained ..... 155
Fellowships at Missouri School of Mines ..... 156
Vitrified Paving Brick Schedule Reaffirmed ..... 156
Proposed Brick, Tile, and Heavy Ware Section of the Ceramic Society ..... 156
American Construction Council to Issue Book ..... 157
Simplification Meeting on Porcelain Plumbing Fixtures, May 22 ..... 157
The Steel Sanitary Company ..... 157
Junior Ceramic Technologist ..... 158
Notes from the Bureau of Standards ..... 158
Program for Canadian N.C.P. Assn. ..... 162

**Calendar of Conventions** ..... 162

**Advertisers' Index** ..... 29

# H F & G PRODUCTS ARE RELIABLE

CONTROL of all the processes in the manufacture of Ceramic chemicals by **H F & G** from the raw materials to the finished product insures uniformity of excellence.

The wide range of requirements and varied applications demand such control. Our years of experience, close study of physical and chemical properties, etc., is your insurance of quality.

Look for the well known **H F & G** mark.

THE HARSHAW FULLER AND GOODWIN CO.

Cleveland

Chicago New York Philadelphia

*(When writing to advertisers, please mention the JOURNAL)*

# METHODS FOR TESTING CRAZING OF GLAZES CAUSED BY INCREASES IN SIZE OF CERAMIC BODIES[1]

By H. G. Schurecht

ABSTRACT

Investigations to determine the causes of a type of crazing which develops on certain glazed ceramic wares, some time after firing, revealed the fact that in many cases such crazing is caused by an expansion of the body. This is probably due to the combination of water with the body, while the glaze remains practically constant in size. A body may be tested for this type of crazing by placing the glazed specimens in an autoclave and subjecting them to a steam pressure of 150 to 175 pounds per square inch for one hour. Bodies showing the least tendency to develop this type of crazing are those which have a low porosity, are not very soluble in sulphuric acid, and have a low ignition loss above 110°C.

## Introduction

It is a well-known fact that when a glaze contracts more than the body in cooling from the temperature at which it becomes rigid down to room temperature, it may craze. This type of crazing usually occurs in cooling and therefore is generally apparent on the ware upon removal from the kiln, although in certain instances it first appears a short time after it has been removed.

In other cases the glazes will first craze a year or more after they have been fired and the purpose of this work was to investigate the causes of this type of crazing. It was thought at first that this crazing was caused by tension strains in the glaze which caused it to fail from fatigue after a lapse of time, but upon investigation it was discovered that in many cases it developed on ware where the glazes were not under strain or were in compression when the ware was removed from the kiln. This led to the conjecture that the body had expanded while the glaze and the vitrified portion beneath it remained constant in size, thus producing tension strains in the glazed surface tending to cause crazing. An investigation was undertaken to test this hypothesis and the results to date tend strongly to confirm it. Methods were also developed for testing the resistance of glazed ceramic bodies to this type of crazing.

## Crazing of Glazes Due to Increasing Size of Ceramic Bodies

### Indirect Measurements of Expansion Due to Storage

A body apparently free from crazing when removed from the kiln but which became crazed after twelve years outdoor storage

[1] Publication approved by the Director of the National Bureau of Standards, U. S. Department of Commerce and the National Terra Cotta Society. Presented at the Annual Meeting, American Ceramic Society, Atlantic City, N. J., February, 1928. (Terra Cotta Division.) Received March 5, 1928.

was first studied. The thermal expansions of the body and glaze were determined by the interferometer method[2] from 20°C to 720°C. After the tests had been conducted to 720°C, the specimens were allowed to cool in the furnace to 20°C and expansion determinations were made a second time up to 720°C. The results for the body are shown in Fig. 1.

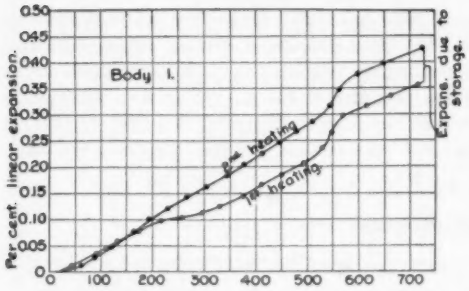



FIG. 1.—Expansion curves of a body on which the glaze crazed due to storage.

Obviously the expansion curve obtained during the first heating is much lower than that found for the second. The expansion curve obtained during a third heating approximately checks that of the second. Likewise, repeated tests seemed to check approximately the curve obtained for the second test.

It seems, therefore, that the expansion curve obtained in the second heating is probably the true thermal expansion curve of this body. That found in the first is lower than the true thermal expansion curve because the body has contracted a certain amount, evidently because of the expulsion of combined water during heating. The changes taking place may be shown more plainly by means of the following formula:

Let $E_t$ = per cent true thermal expansion of the body at any temperature
Let $C$ = per cent linear contraction caused by driving off combined water[3]
Let $E_1$ = "resultant" expansion of first heating at any temperature
Let $E_2$ = "resultant" expansion of second heating at any temperature

Hence $E_1 = E_t - C$
But $E_2 = E_t$
Therefore $C = E_t - E_1 = E_2 - E_1$ (1)

If a body contracts while being heated below 700°C, we may assume that it has expanded an amount greater than the contraction during the time that has elapsed since it was originally fired.

Substituting in (1) for the Body 1 we find that $C$ is equal to 0.09% at 600°C and, therefore, we may assume that it has increased in size 0.09% or more since it was originally fired.

Similar expansion determinations were made on chips of glaze removed from the body and it was found that the expansion curve ob-

[2] George Merritt, "Application of the Interferometer to Measurements of the Thermal Dilatation of Ceramic Materials," Bur. Stand., *Sci. Paper*, No. 485 (1924).

[3] The term "combined water" is used throughout this paper to designate the water taken up by the body. Just how this water is combined with the body remains to be proved, but most of it is driven off between 200° and 350°C.

tained during the second heating was approximately equal to that obtained during the first (see Fig. 2). Substituting in (1) for the glaze, we find that $C$ is equal to 0%. It appears, therefore, that the body expanded approximately 0.09%, whereas the glaze remained practically constant, which would tend to throw the glaze in tension and cause crazing.

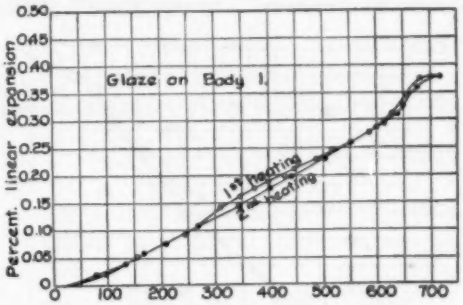



FIG. 2.—Expansion curves of glaze which crazed on Body 1 due to storage.

In Fig. 3 is shown the probable contraction of body and glaze during cooling and also their expansions during outdoor storage for 12 years. Assuming that the glaze became rigid at 680°C[4] it is probable that the glaze was in compression when it was removed from the kiln since the body contracted more than the glaze from 680°C to 20°C. Hence it was probably free from crazing directly after removing from the kiln. Upon storage, however, the body expanded while the glazed surface remained practically constant in size and thus caused crazing as explained.

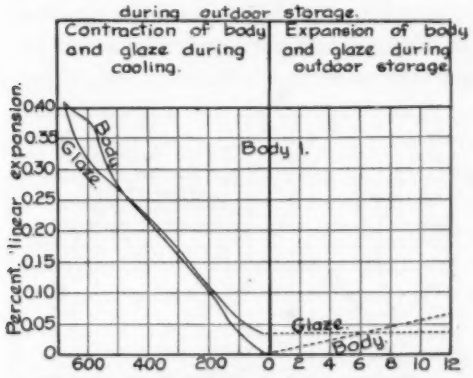



FIG. 3.—Probable contraction of body and glaze during cooling and expansion during outdoor stage.

Similar tests were made on Body 2 on which the glaze **did not** craze after 12 years outdoor storage. The results show that the expansion curves for the first and second heatings were practically the same, indicating that the body had not expanded. The fact that the body had not expanded in this case evidently accounts for the absence of crazing on this ware (see Fig. 4).

**Direct Measurements of Expansions Due to the Action of Water**

In the above tests the expansions of the bodies were determined indirectly after they had already expanded due to the action of water, by measuring their contractions during heating. These tests were verified in this portion of the work by measuring

[4] G. E. Merritt and C. G. Peters, "Interferometer Measurement of the Thermal Dilatation of Glazed Ware," *Jour. Amer. Ceram. Soc.*, 9 [6], 327–42 (1926).

the increases in size caused by the action of water directly. Bars, 24 inches long, made of four ceramic bodies, were fired to cone 4 in order to drive off any combined water which might be present and their lengths at 20°C were measured shortly after firing by means of a microscopic comparator.[5]

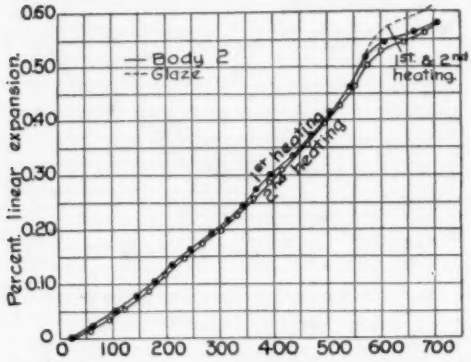



FIG. 4.—Expansion curves of a body on which the glaze did not craze after long storage.

They were then subjected to a steam pressure of 150 pounds per square inch in an autoclave for two hours, dried at 110°C and the resultant increase in their lengths at 20°C was measured. They were then heated to 330°C, cooled, measured at 20°C, heated to 450°C and, after cooling, again measured at 20°C.

The changes in size of the specimens caused by these treatments are shown in Fig. 5 and a brief summary of these is given below.

(1) The bodies were larger by 0.057 to 0.126%, after heating in an autoclave at a steam pressure of 150 pounds per square inch for two hours, than they had been immediately after firing.

(2) Heating the same specimens to 330°C after the above treatment caused them to contract 0.032 to 0.074%.

(3) Firing the same specimens (previously fired to 330°C) to 450°C caused three to contract 0.0073 to 0.015% more while one expanded 0.0073%.

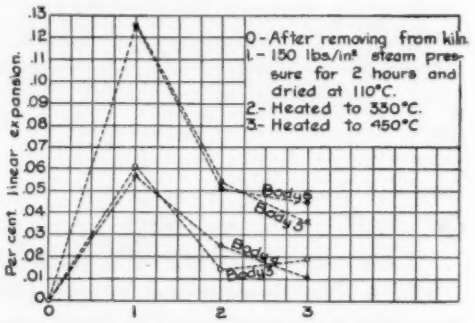



FIG. 5.—The influence of different treatments on the changes in length of four bodies.

The results indicate that the contractions obtained by heating the specimens which were originally expanded in the autoclave or by weathering are somewhat less than the original expansions. Hence we may determine, approximately, how much an old ceramic body has expanded by

[5] The comparator used in this work was designed by C. S. Laubly of the Bureau and is described in "Shrinkage of Portland Cement," by J. C. Pearson, Amer. Concrete Institute, 1921.

measuring its contraction upon heating to 600°C or above by using the method described in the first portion of this paper.

### Some Methods of Testing This Type of Crazing

In order to develop laboratory tests which would measure the resistance of a body to the crazing attributable to hydration in storage the following tests were conducted on 11 glazed ceramic bodies:

(1) Absorption after two hours boiling and 24 hours soaking in water.
(2) Solubilities in sulphuric acid.
(3) Ignition losses above 110°C after outdoor storage for three years.
(4) Subjecting specimens to a steam pressure of 150 pounds per square inch in an autoclave for one hour.
(5) Storing glazed specimens outdoors for three or more years.

After the glazed specimens had been subjected to a steam pressure of 150 pounds per square inch for one hour, they were inspected for crazing by applying a malachite green solution to the surface. The specimens stored outdoors were also inspected for crazing in a similar manner.

In testing the solubilities of the bodies in sulphuric acid, the method used by O. Kallauner and R. Barta[6] was employed, which was as follows:

The bodies were ground to 80- to 100-mesh size, care being taken not to include the glaze. These granular samples were washed thoroughly with distilled water to remove the dust which clings to the particles. Any iron introduced in grinding was removed by means of a magnet. The samples were then thoroughly dried at 120°C. About one gram ($V_1$) of each was put in Erlenmeyer flasks of 200cc. capacity and boiled with 22 cc. of concentrated $H_2SO_4$(sp. gr. = 1.84) for one hour, after which the flasks were cooled 5 minutes in air and then the solutions were poured off. The flasks were then cooled by dipping them in water, after which 50 cc. of water were added to each. The solutions were then filtered and the residues in the flasks washed three times with water. Fifty cubic centimeters of 5% sodium carbonate solution were put in each flask and they were heated on the water bath for 15 minutes, stirring every 5 minutes. The sodium carbonate solutions were then filtered off and the residues washed three times with 50cc. of water and then 5 drops of concentrated hydrochloric acid. The ground residues were washed free from chlorides and then transferred to a crucible and weighed, this weight being $V_2$. Separate one-gram samples of the same materials were ignited and losses in weight in-

[6] O. Kallauner and R. Barta, "The Determination of the Resistance of Ceramic Products toward Solutions Especially Acid," *Sprechsaal*, **54**, 301–303, 316–318, (1922).

dicated by (2). The percentage loss in weight due to sulphuric acid treatments was calculated from the formula:

$$(2) \qquad \frac{(V_1-Z)-V_2}{V_1-Z}\times 100$$

The results are shown in Table I and are summarized below:

(1) It is apparent upon examining the table that those bodies which became crazed in the autoclave test also crazed after storage outdoors for three or more years while those bodies which did not craze in the autoclave test remained free from crazing in the outdoor tests. It seems, therefore, that by subjecting glazed ceramic bodies to a steam pressure of 150 to 175 pounds per square inch for one hour we can usually predict whether the glaze will craze in the future during storage.[7] If the glaze crazes in the autoclave test, it will probably craze in the future, which may be one or more years after it has been fired.

(2) In general the more vitreous bodies are less apt to develop this type of crazing than the porous ones.

TABLE I

THE RELATION BETWEEN SOME PROPERTIES OF CERAMIC BODIES AND THEIR TENDENCY TO CRAZE IN THE AUTOCLAVE TEST AND DURING OUTDOOR STORAGE

(All glazes were free from crazing before test)

| Body | Absorption after 2 hours boiling and 24 hours soaking (per cent) | Loss in weight due to sulphuric acid treatment* (per cent) | Ignition loss after outdoor storage 3 or more years (per cent) | Condition of glaze after treatment in an autoclave at 150 lbs./sq. in. steam pressure for one hour | Condition of glaze after storage outdoors 3 or more years |
|---|---|---|---|---|---|
| 1 | 8.0 | — | — | Crazed | Crazed |
| 2 | 3.0 | — | — | Not crazed | Not crazed |
| 3 | 9.2 | 15.4 | 0.23 | Crazed | Crazed |
| 4 | 15.5 | 15.7 | 0.13 | " | Slightly crazed |
| 5 | 16.0 | 16.7 | 0.17 | " | Crazed |
| 6 | 10.2 | 15.5 | 0.13 | " | " |
| 7 | 17.0 | 17.5 | 0.23 | " | " |
| 8 | 11.2 | 9.3 | 0.09 | Not crazed | Not crazed |
| 9A (semivitreous whiteware) | — | 10.5 | 0.11 | Crazed | — |
| 10A (vitreous whiteware) | 0.01 | 4.5 | 0.04 | Not crazed | Not crazed |
| 11A (stoneware) | 0.5 | 5.5 | 0.03 | Not crazed | Not crazed |

* The solubility of the bodies in sulphuric acid and their ignition losses were expressed in terms of total weight of body because the exact clay content of these bodies was not known. In subsequent work it was found that a more significant figure is obtained by expressing the solubility in terms of the calcined clay content of the bodies.

(3) Bodies having a low solubility in sulphuric acid are less apt to craze from expansion of the body caused by hydration than those having a greater solubility in sulphuric acid.

(4) Bodies having low ignition loss above 110°C after three or more

[7] Storage does not necessarily have to be outdoors or in contact with water as it was found that certain ceramic bodies expand during indoor storage apparently due to the action of moisture in the atmosphere.

years storage in general show less crazing than those having a high ignition loss. This is further evidence that the expansion of ceramic bodies is caused by a combination of water with certain portions of the bodies.

The following tentative autoclave test for determining the resistance of glazed ceramic ware to crazing owing to an increase in size of ceramic bodies is recommended for consideration:

Place specimens having a glazed area of about 4 by 4 inches above the water in an autoclave similar to that shown in Fig. 6. For testing ware which is glazed on all sides like white ware, it may be advisable to break it so that the body will be exposed. After sealing the vessel, apply enough heat to produce a pressure of 150 to 175 pounds per square inch in about one hour by regulating burner and observing pressure gage. Hold this pressure for one hour and then open the steam valve so as to reduce the steam pressure to zero. Remove the specimen and determine if crazing has taken place by applying a malachite green or similar colored solution to the glazed surface. If the glaze withstands this treatment, it will probably always remain immune to crazing from increase in size of the ceramic body.

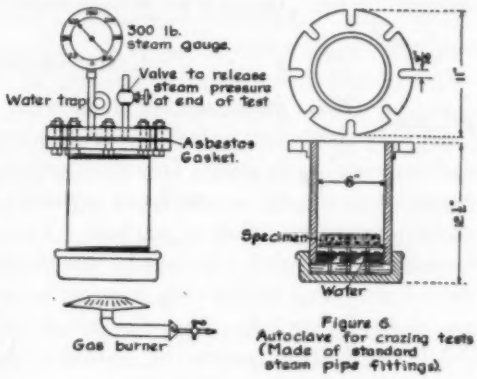



FIG. 6.—Autoclave for crazing tests (made of standard steam-pipe fittings).

# THE PREVENTION OF DISINTEGRATION OF BLAST FURNACE LININGS[1]

By Himansu Kumar Mitra[2] and Alexander Silverman

ABSTRACT

Theories and observations on the causes of disintegration of fireclay refractories in blast furnaces are given and a process is developed for improving high iron clays for this use. The disintegration of refractories in blast furnace linings is initiated by alteration in the iron spots. Ferric oxide is reduced to ferrous oxide at 500°C and hastens the cracking of 2CO to $CO_2+C$, the carbon being retained by the lining. When $Fe_2O_3$ is converted to $Fe_3O_4$ the brick will not disintegrate.

## I. Introduction

**Purpose** Blast furnaces are lined with fire brick which must be relatively low in iron content to resist the disintegrating action of carbon monoxide gas. This disintegration is brought about by iron compounds acting as catalysts toward CO and its auto-oxidation with consequent deposition of carbon. The present practice in the manufacture of fire brick consists in weathering the clay for a long time till the iron pyrites in the clay assume a brown color. The brown masses are then discarded. The clay thus improved is given a hard firing. While hard firing leaves the residual iron in a condition that can resist the disintegrating action of the gases much better, it makes the brick less resistant to spalling. The present investigation is aimed at the utilization of high iron clays for the manufacture of fire brick for blast furnaces.

**Review of Previous Work** Various suggestions have been made from time to time as to the cause of the disintegration of blast-furnace linings. Investigations in three different fields of study have contributed materially. These are:

(1) Investigations of the reactions going on in a blast furnace, especially regarding the reduction of the ore and changes suffered by the gases, particularly carbon monoxide.
(2) The study of the equilibrium reaction $2CO \rightleftharpoons CO_2+C$.
(3) Attempts to solve lining problems.

Carbon absorbed by the refractories is the cause of their disintegration, but the previous workers do not seem to have got a precise insight into all the reactions involved in this deposition. The identity of the catalyst has not so far been established.

---

[1] Presented before the Refractories Division at the Thirtieth Annual Meeting of the American Ceramic Society, Atlantic City, N. J., February, 1928.

[2] Submitted to the Graduate School of the University of Pittsburgh in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

One of the very early theories that has very few votaries is that disintegration is brought about by the formation of silicon carbide. Schreiber[3] does not find any silicon carbide even in the very badly distintegrated bricks and therefore dismisses it as a possibility.

Zimmerman[4] made a special study of the catalytic decomposition of carbon monoxide in contact with free iron. He found that the reaction $2CO \rightleftharpoons CO_2 + C$ takes place at temperatures below 780°C. He also mentions that iron is oxidized to ferrous oxide by $CO_2$ at temperatures between 445°C and 508°C.

Osann[5] advanced experimental evidence in support of the theory that disintegration of blast-furnace bricks is brought about by the continued deposition of carbon in the pores of the brick through the catalytic decomposition of carbon monoxide according to the reaction $2CO \rightleftharpoons CO_2 + C$. Small amounts of iron in the bricks act as the catalyst. His experiment consisted of testing the action of a slow current of carbon monoxide on a refractory fire brick placed in porcelain boats inside a heated closed tube. The optimum temperature for this reaction is 400° to 500°C.

Ross[6] suggested that increase of ferric oxide in the brick stack line causes disintegration. Disintegration, he notes, occurs in a zone where temperature is between 400° and 800°F.

Wilbaut[7] utilized the above-mentioned reaction at temperatures between 450° and 470°C in trying to form ash-free carbon. He used FeO as the catalyst and found this still remained unchanged.

According to Menke[8] disintegration is brought about by the deposition of zinc impurity in ore in linings. His suggestion lacks experimental confirmation. Cases of blowout studied by him showed presence of zinc around the blowholes, and a very small amount of zinc is sufficient to cause rupture, since the expansion ratio of zinc to silica (main constituent of fire brick) is about three to one. According to Howe[9] very few cases of disintegration are attended with zinc deposition. In zinc metallurgy those portions of fireclay condenser which are in a certain temperature range suffer most. If zinc deposition be a cause at all, it is a minor rather than a major one.

An exhaustive study of the problem has been made by Nesbitt and Bell.[10] By exhaustive laboratory experiments and experiments in

[3] *Stahl u. Eisen*, **33**, 407–408 (1913); *Chem. Zentr.*, **1**, 2187 (1913).
[4] *Met. Chem. Eng.*, **8**, 182–84 (1910).
[5] *Stahl u. Eisen*, **27**, 1626–28 (1907).
[6] *Iron Age*, **105**, 117–18 (1920).
[7] *Rec. Trav. Chim.*, **41**, 116–18 (1922).
[8] *Blast Fur. Steel Plant*, **10**, 116–18 (1922); *Iron Trade Rev.*, **70**, 1409–10 (1922).
[9] *Ibid.*, **10**, 161–63 (1922).
[10] *Brick and Clay Rec.*, **62**, 1042–43 (1923).

large-scale operations, they definitely established the fact that ferric oxide which is formed from pyrites present in the fire clay, when burned, acts as a catalyst toward carbon monoxide at temperatures between 420° and 470°C, when copious carbon deposition takes place. All those bricks which lie in the zone of this temperature range suffer badly. These authors disposed of the theory that superheated steam or foreign materials caused the trouble.

Working on zinc metallurgy, O'Harra and Darby[11] came to similar conclusions. They found that the portions of the condenser which had temperatures between 450° and 600°C disintegrated.

Gilard's[12] conclusions confirm those of the four previous workers.

Farup's[13] studies on catalytic oxidation of carbon monoxide in the presence of iron oxides again indicate 400° to 500°C as most favorable.

Fundamental investigations on the equilibrium reaction mentioned above by Stansfield[14] are important, for he critically reviews the works of previous investigators like Boudouard[15], Rhead and Wheeler[16] and others, and then gives his own data. Boudouard had studied the equilibrium from 445° to 925°C, reached both from the CO and $CO_2$ side and obtained a curve for this equilibrium. Rhead and Wheeler approached the equilibrium from the $CO_2$ side alone for temperatures 850° to 1200°C. They were unable to establish equilibrium below 800°C. Other workers extrapolated Rhead and Wheeler's curve from 800° to 700°C. Stansfield questioned the results. He found however by applying Le Chatelier's equations for lower temperatures to Rhead and Wheeler's data (from 850° to 1200°C) that Boudouard's curve was substantiated.

An entirely novel suggestion for carbon deposition was made by Hilpert and Dieckman[17] who claim that deposition is brought about by intermediate formation of iron carbide. They studied the action at temperatures around 950°C in the presence of pure ferric oxide catalyst. At that temperature, ferric oxide was reduced to iron and no carbon formed. At 850°C slight deposition of carbon occurred, the amount increasing with temperature decrease. Since iron carbide formed at 850° and carbon deposition started at the same temperature, the two phenomena seemed related. Carbon formation was presumably brought about by intermediate formation of $Fe_2C$ and FeC which

[11] *Jour. Amer. Ceram. Soc.*, **6** [8], 904 (1923).
[12] *Rev. Universelle des Mines de Liege*, Dec. 1, 1923; *Le Genie Civil*, **84**, 457–58 (1924).
[13] *Tids. kemi Bergvesen*, **6**, 1–6, 15–17 (1926).
[14] *Trans. Am. Electrochem. Soc.*, **51** (Reprint) (1927).
[15] *Ann. Chim. Phys.*, [Series 7], **24**, 5 (1901).
[16] *Trans. Chem. Soc.*, **97**, 2178 (1910).
[17] *Ber.*, **48**, 1281–86 (1915).

rapidly change to stable $Fe_3C$, with separation of carbon. Previous references show that we need not assume the existence of hypothetical intermediate carbides.

It seems to be well established that "iron spots" in bricks are the zones where disintegration starts. The reason why most of the workers mention 400° and 600°C as the optimum temperature for the disintegration is explained in Boudouard's[15] data which show that the equilibrium is preponderatingly on the $CO_2$–C side at these temperatures. As the temperature goes higher equilibrium shifts to the CO side and carbon deposition and brick disintegration cease.

## II. Procedure

While it is generally agreed that "iron spots" are the source of trouble, no special efforts have so far been made to definitely establish the identity of the catalyst. Knowing that the source of iron in the brick is the mineral pyrites ($FeS_2$) in the clay, it is quite probable that some pyrites may still remain unconverted to $Fe_2O_3$ even after the brick has been fired, and that this might act as the catalyst. Besides forming $CO_2$ and carbon, CO probably reduces the ferric oxide, and so there is the possibility that $Fe_3O_4$ may be formed with FeO, or Fe, each of which alone, or all together, may play the rôle of catalysts. This investigation therefore strives:

(1) To find out which substance or substances in the "iron spots" act as catalyst.
(2) To prevent this catalytic action.

**Carbon Monoxide** The gas was generated by dropping pure formic acid on to heated sulphuric acid. Concentrated sulphuric acid was heated in flask *A* (Fig. 1) to about 100°C and formic acid was slowly dropped from the funnel *B*. The evolved gas passed out of the three-way tube, through a tin canister, *C*, which contained soda lime so packed as to insure a large absorption surface for acid vapors. It passed down another soda lime tower, *D*, and then through pyrogallol solution, to absorb oxygen before entering a gas holder. Further purification took place in three Milligan bottles, *F*, the first of which contained concentrated potassium hydroxide solution and the other two, alkaline pyrogallol solution. Then the gas passed through a flow meter, *G*, and a wash bottle, *H*, containing water. The wash bottle prevents evaporation of the indicator liquid in the flow meter. Calcium chloride tube, *I*, and the phosphorus pentoxide tube, *J*, serve as driers. From the last tube it passed to the furnace, through a three-way tube. Two furnaces were used, which are described in detail below. The furnaces were closed with rubber stoppers, provisions being made for letting

the gases in and out and also for inserting a thermocouple. From the furnace the gas passed through another three-way tap, through an empty conical flask, *K*, through a drying bottle, *L*, containing sulphuric acid and then to a large aspirator, *M*. The screw clamp, *N*, on the siphon of the aspirator controlled the rate of flow of gas through the whole system. The adjunct to the left of the generating flask, *A*, is a safety trap. In case excess pressure was developed within *A*, the gas flowed out through the water-seal and then to the hood. The gas thus prepared analyzed:

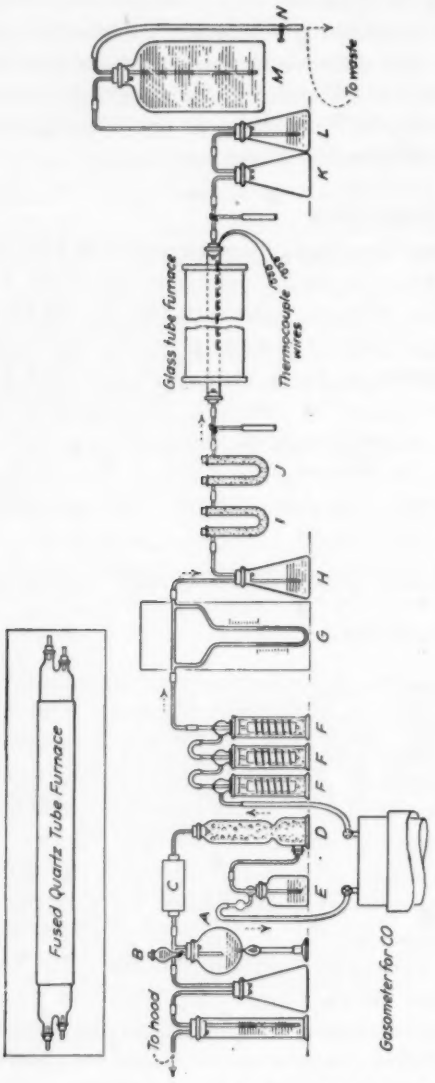



FIG. 1.

| | Per cent |
|---|---|
| $CO_2$ | 0 |
| $O_2$ | 0.4 |
| CO | 97.4 |
| $N_2$ | 2.2 |

**Ferric Oxide** Pure ferric nitrate was dissolved in distilled water and filtered. It was acidified with nitric acid, boiled, and precipitated by ammonium hydroxide. The precipitated ferric hydroxide was filtered, washed free from nitric acid, dried, and ignited in an electric muffle furnace. Its purity was checked by analyzing a sample by dissolving in hydrochloric acid and titrating with potassium dichromate solution.

**Ferrosoferric Oxide** Ferrosoferric oxide was prepared from the pure ferric oxide by Hilpert and Bayer's method,[18]

[18] *Ber.*, **44**, 1608–1609 (1911).

with modifications. $Fe_2O_3$ was reduced at 400°C by hydrogen saturated with water vapor at 40°C.

The apparatus consisted of a glass tube, *A* (Fig. 2) laid in a small electric furnace. It was closed with two rubber stoppers, the one through which the gas entered having a single hole to let gas in and the other with two holes, one for letting the gas out and the other for inserting a thermocouple. A quartz boat containing the pure $Fe_2O_3$ was placed about the middle of the tube and a coil of copper gauze placed before the boat. Hydrogen from a tank was employed. It was passed passed through a wash bottle, *B*, containing potassium hydroxide solution, to remove acid vapors, through a flow meter, *C*, through two Milligan bottles *D*, *D*, containing alkaline pyrogallol, and then through a series of wash bottles, *E*, containing water, immersed in a thermostat, whose temperature was maintained at 40°C. The gas next passed through a three-way tube, *F*, to the furnace whence it escaped through an empty flask and a wash bottle containing water. The tube leading from the thermostat, and the three-way tube were heated electrically so that moisture-laden hydrogen would not deposit its load. The third way of the tube, *F*, was connected to a nitrogen tank through a purification train for that gas, *G*, containing alkaline pyrogallol and, *H*, calcium chloride.

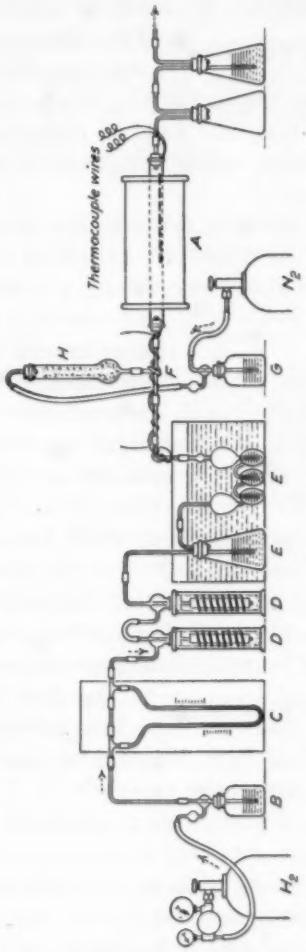



FIG. 2.

To start with, a stream of purified nitrogen from the tank was passed through the apparatus to drive air out. Nitrogen was then shut off and hydrogen started. The temperature of the furnace was raised to 400°C and the temperature read by means of a chromel-alumel thermocouple and millivoltmeter, as described later. After the action on $Fe_2O_3$ had proceeded far enough the current of hydrogen was shut off and the furnace cooled to room temperature before allowing any air to enter. The reduction in weight of the boat

as well as the actual analysis, indicated whether or not $Fe_3O_4$ had formed. The reaction is extremely delicate, and although not mentioned by Hilpert and Bayer, the rate of flow of gas is an important factor, a slight deviation from the optimum conditions being fatal to the success of the experiment. It was found that for 0.3 to 0.4 gram of ferric oxide a flow of about 425 cc. of gas per hour was most advantageous, with a heating period of an hour and a quarter to an hour and a half at 400°C.

**The Furnaces** Two furnaces were employed, one for reactions at temperatures up to 500°C and the other for temperatures above 500°C. The first consisted of a Pyrex glass tube about 90 cm. long and 3 cm. in diameter. This was laid in an electrically heated furnace, whose temperature was controlled by an external slide resistance.

The other furnace, was a fused quartz tube 1.2 meter long, and 10 cm. in diameter, to whose ends were attached two quartz stoppers each about 17 cm. long, ground so as to avoid leaks. These two stoppers had openings for suitably bored rubber stoppers, to let gases in and out, and for inserting the thermocouple. The main tube had a central heating coil of heavy chromel wire (B. & S. gage No. 13) extending over a length of about 30 cm. The coiling of this heavy wire was about five turns to 3 cm. There were two other coils one at each end of the main coil and covering a length of 15 cm. each, the end coils being connected in series. Each of these two units was connected to two table sockets through suitable slide resistances for controlling temperatures. The function of the two outer coils is to prevent cooling of the central portion by radiation. The heating elements were coated with magnesia-asbestos cement.

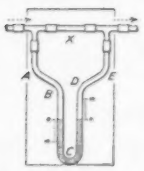


FIG. 2*a*.

**The Flow Meter** The flow meter was designed to indicate rates of flow up to ten liters. It was made from a glass tube *A-B-C-D-E* (Fig. 2*a*) bent as shown in the figure. Two glass *T*-pieces connected the two ends, *A-E*, with the horizontal capillary tubing, *X*. The *T*-pieces were connected by means of thick-walled rubber tubing to the capillary and other tube. The U-shaped portion, *B-C-D*, was half-filled with water, colored red by alkaline phenolphthalein. The whole arrangement was mounted on a wooden support with *B-C-D*, vertical and *X* horizontal. Gas entered and left as indicated by arrows. It was calibrated for rates of flow up to ten liters per hour.

**The Thermocouple** Temperature was measured by means of a chromel-alumel thermocouple. The couple was fused at one end and was incased in a thin double-holed refractory sheath, the whole being slipped inside a Pyrex-glass or silica tube as

occasion demanded. The loose ends were dipped in two tubes containing mercury, placed in a freezing mixture of ice and water contained in a vacuum flask. Two copper wires leading from these mercury tubes completed the circuit through a millivoltmeter. The couple was calibrated by comparing with a standard platinum platinum-iridium couple.

**Experimental Details** The first few experiments conducted were necessarily a repetition of the work carried on by previous investigators to establish the validity of their conclusions.

(1) Pure $Fe_2O_3$ and a piece of refractory fire brick were treated with a slow current of carbon monoxide, about a liter per hour, for 8 to 10 hours at 950°C.

Results are given in Table I.

TABLE I

| | Weight of $Fe_2O_3$ (grams) | Temperature: 950°C Period of Heating (hours) | Percentage of iron |
|---|---|---|---|
| (1) | 0.1013 | 8 | 99.76 |
| (2) | 0.1109 | 8.5 | 99.75 |
| (3) | 0.1003 | 9 | 99.77 |

No carbon could be detected on dissolving the mass in hydrochloric acid, when copious evolution of hydrogen could be seen. After identical treatment another sample of ferric oxide showed the presence of iron on treating with copper sulphate solution and examining in reflected light under the microscope.

(2) The same investigation was repeated at 500°C with small pieces of fire brick.

A piece of fire brick, made with addition of 14.1% $FeS_2$ to a sample of clay, on similar treatment had its "iron spots" stained red on touching with copper sulphate solution thus showing reduction to iron. This sample did not show any disintegration. A sample of the same batch disintegrated badly at 500°C. The disruption at the lower temperature started from the iron spots. No iron formation could be observed at 500°C.

(3) This experiment was qualitative rather than quantitative. Definite amounts of pulverized magnetite, ferrous oxide, iron powder, and ferric oxide each contained in separate weighed quartz boats, were placed in the furnace in the order mentioned. A weighed empty boat completed the train. This series of boats was subjected to the action of carbon monoxide gas at 500°C for six hours. The boats were weighed after cooling in the furnace. The increase in weight of the boats roughly indicated the amount of carbon deposition. The run lasted six hours at 500°C. Flow of gas was one liter per hour. Results are given in Table II.

TABLE II

| | Substance | Temperature 500°C: Percentage increase in weight | Remarks |
|---|---|---|---|
| (1) | Magnetite | 1.1 | Slight carbon formation |
| (2) | FeO | 40 | Copious deposition |
| (3) | Fe | 41 | " " |
| (4) | $Fe_2O_3$ | 66.63 | " " |
| (5) | Empty boat | nil | nil |

All residues were attracted by a magnet.

(4) The action of one liter of CO per hour, on pure $Fe_2O_3$ was the subject of more detailed quantitative study. About 0.05 to 0.06 g. of the pure oxide was weighed out in a quartz boat and the action of CO at 500°C studied. The choice of 500°C was more or less an arbitrary one, but was chosen since it falls within the optimum temperature range for auto-oxidation of CO and is a convenient working temperature. The course of the action was followed by analyzing samples of gas drawn from time to time. It can easily be seen that the percentage of $CO_2$ formed gave a fair indication of the amount of carbon deposited. The residue was analyzed to ascertain which oxide of iron formed.

Results are given in Table III.

TABLE III

| | Period of heating in hours | Temperature 500°C: Percentage of $Fe_2O_3$ reduced to FeO | Remarks |
|---|---|---|---|
| (1) | 5 | 88.6 | |
| (2) | 8 | 93.5 | Copious deposition of carbon in all cases |
| (3) | 12 | 97.1 | |
| (4) | 14 | 99.4 | |

No metallic iron could be detected. The residues were all magnetic.

TABLE IV

PERCENTAGES OF $CO_2$ FORMED IN EXPERIMENT 4

| Hours from start | Run Number 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1 | 36.6 | 39.1 | 39.8 | 37.4 |
| 2 | — — | 35.5 | — — | — — |
| 3 | 47.1 | 41.1 | 43.3 | 44.8 |
| 4 | 46.8 | — — | — — | — — |
| 5 | 41.2 | 40.0 | 43.2 | 48.4 |
| 6 | — — | — — | 48.2 | — — |
| 7 | — — | 36.5 | 33.8 | 43.3 |
| 8 | — — | — — | 18.8 | — — |
| 9 | — — | — — | 18.7 | 20.1 |
| 11 | — — | — — | 13.0 | 15.3 |
| 12 | — — | — — | 12.1 | — — |
| 13 | — — | — — | — — | 13.2 |

(5) Pure $Fe_3O_4$ whose preparation has already been described was subjected to action like $Fe_2O_3$ in Experiment 4. Results are given in Table V.

TABLE V

TEMPERATURE 500°C

| Period of expt. (hours) | Variation in weight (per cent) | Per cent FeO | |
|---|---|---|---|
| | | Original | Final |
| (1) 8 | +0.003 | 31.0301 | 31.0303 |
| (2) 8 | −0.001 | 31.0301 | 31.0299 |
| (3) 10 | nil | 31.0293 | 31.0295 |
| (4) 12 | +0.002 | 31.0293 | 31.0289 |

No carbon could be detected

TABLE VI

PER CENT OF $CO_2$ FORMED IN EXPERIMENT 5

| Hours after start | Number | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| 1 | 1.1 | 1.2 | 0.9 | 0.8 |
| 2 | 1.2 | — — | 0.9 | — — |
| 3 | 0.8 | 0.6 | — — | 1.1 |
| 4 | — — | — — | 1.2 | — — |
| 5 | 1.0 | 0.6 | — — | — — |
| 6 | 0.7 | — — | 0.8 | — — |
| 7 | — — | 0.6 | — — | 0.9 |
| 8 | 1.0 | — — | 0.9 | — — |
| 10 | — — | — — | 0.8 | — — |
| 11 | — — | — — | 0.8 | — — |

(6) Pieces of fire brick were subjected to the action of $H_2$ and water vapor in the outfit described for the preparation of $Fe_3O_4$ so as to convert $Fe_2O_3$ in the brick to $Fe_3O_4$. The pieces thus treated were then subjected to the action of CO at 500°C and higher temperatures. The pieces did not disintegrate.

Results are given in Table VII.

TABLE VII

PERCENTAGE OF $CO_2$ FORMED IN EXPERIMENT 6

| Hours after start | Run number | | Hours after start | Run number | |
|---|---|---|---|---|---|
| | 1 | 2 | | 1 | 2 |
| 1 | 0.9 | — — | 8 | 1.6 | — — |
| 2 | 1.2 | 1.1 | 9 | — — | 1.4 |
| 3 | 1.1 | — — | — — | — — | — — |
| 4 | — — | — — | 11 | — — | 1.2 |
| 5 | — — | 1.6 | — — | — — | — — |
| 6 | 1.4 | — — | 14 | — — | 1.2 |

(7) Pieces of "iron spots" of fire brick were carefully picked out and tested for sulphides. None were found.

(8) "Iron spots" in the fire brick were tested for metallic iron with negative results. The quantitative estimation of free iron, where its presence is suspected depends on the fact that a neutral solution of mercuric chloride dissolves iron without affecting the oxides according to the equation:

$$Fe + HgCl_2 = FeCl_2 + Hg$$

Ferrous chloride thus formed is titrated with standard permanganate

solution, in presence of manganous sulphate and a large excess of water.

(9) Free carbon may be detected in presence of the oxides of iron by boiling with hydrochloric acid. It remains as a black undissolved residue. This is collected on asbestos, washed and dried, and subjected to combustion. The carbon dioxide is determined by the usual absorption method.

(10) For the qualitative detection of iron and its oxides in presence of one another in a solid mixture a microchemical method due to Brammal[19] was adopted with slight modifications. It consisted of sprinkling a little of the powder on a glass slide, adding a drop or two of hydrochloric acid, and drying in an oven. Potassium thiocyanate showed presence of red crystals, in transmitted light if the powder contained ferric oxide. Potassium ferrocyanide showed a blue pigment in reflected light on similar treatment. Potassium ferricyanide similarly gave a blue pigment if the mass contained ferrous oxide. The presence of iron was best detected in reflected light by treating the powder with acidified copper sulphate solution when the latter was coated red.

(11) For rapidly estimating high concentrations of CO, hopcalite failed. Also the method of Nesmjelow[20] using heated cupric oxide. The results obtained by the two methods did not check, and the percentage of CO obtained by either method was much lower than the one given by slow combustion in oxygen. The impracticability of the hopcalite method can probably be accounted for by moisture and high concentration of carbon dioxide as pointed out by Lamb and Vail.[21]

(12) Other gases like carbon dioxide and oxygen were estimated by well-known absorption methods.

## III. Discussion of Results

The first experiment conducted (see Experimental Details) was in ignorance of Hilpert and Dieckman's[17] work. It, however, corroborated their conclusion that $Fe_2O_3$ is quantitatively reduced to free iron by CO at 950°C and that there is no carbon deposition. This also explains why at that high temperature CO has no disintegrating action on fire brick. Nesbitt and Bell[10] came to a similar conclusion.

The data obtained by a study of the action CO on $Fe_2O_3$ give ample evidence for deciding which substances in the "iron spots" act as catalysts. Since no sulphides could be detected, the possibility of pyrites acting as a catalyst is excluded. Nesbitt and Bell[10] recognized that

[19] *Geol. Mag.*, **57**, 123 (1920).
[20] *Z. Analyt. Ch.*, **48**, 232 (1909).
[21] *Jour. Amer. Chem. Soc.*, **67**, 123–42 (1925).

$Fe_2O_3$ suffers reduction but they did not attempt to identify the resulting product. O'Harra and Darby,[11] without adducing any experimental evidence, advanced the theory of free iron being the catalyst, iron according to them being produced through the reducing action of carbon monoxide. The bulk of our evidence lends support to the view that ferrous oxide is the catalyst.

In the first place it is seen that the more prolonged the period of action (Table III) the more is the ferric oxide reduced to ferrous oxide, finally approaching 100% FeO. There are two simultaneous reactions going on, one a reduction of $Fe_2O_3$ and the other the catalytic combustion of CO. It is likely that the deposition of carbon hinders the reduction reaction.

Again FeO prepared from ferrous oxalate by Falcke[22] is known to act as a catalyst toward CO in its self-oxidation. He realized that his oxide was not very pure.

Additional evidence in support of the FeO view is found in the work of Wilbaut.[7] He finds FeO unchanged after action of CO between 420 and 470°C. On the other hand, Moissan[23] claimed to have obtained pure FeO, by reducing $Fe_2O_3$ by CO at a temperature of 500°C.

The catalyst in the brick cannot be free iron, since it cannot be dedetected in the "iron spots" before or after prolonged action of carbon monoxide at 500°C. Neither does the residue left from ferric oxide after similar treatment show any trace of free iron. Moreover Zimmerman's[4] study shows that free iron is converted to ferrous oxide by the carbon dioxide formed during the catalytic oxidation at temperatures between 445°C and 508°C. The carbon monoxide formed suffers catalytic decomposition again. His work, therefore, gives support to the view that ferrous oxide rather than free iron is the catalyst in the brick.

The magnetic susceptibility of the residue is probably an apparent contradiction to the assumption that FeO is the catalyst, since ordinarily FeO is known not to be magnetic. But magnetic susceptibility of FeO is not unknown. Ferguson's[24] investigations tend to indicate that there is a form of FeO which is magnetic. He discusses its stability range but does not come to any definite conclusions regarding it.

Sosman and Hostetter[25] in a discussion on the ferrous iron content and magnetic susceptibility of some artificial and natural oxides of iron make a very significant remark, *viz.*, that the relative magnetic susceptibilities are approximately proportional to their percentage of ferrous oxide.

---

[22] *Ber.*, **46**, 743–50 (1913).
[23] *Comp. Rend.*, **84**, 1296 (1877).
[24] *Jour. Wash. Acad. Sci.*, **15**, 279–80 (1925).
[25] *Bull. Amer. Inst. Min. Eng.*, 907–931 (1917).

Then again very pure carbon such as was obtained by Pascal[26] from sugar was shown by him to be magnetic, and we know that carbon obtained from carbon monoxide is very pure.

Even $Fe_2O_3$ is known to be magnetic. Chevallier[27] mentions an instance where $Fe_2O_3$ prepared by him was more magnetic than magnetite.

Thus all the possible substances in the residue from the reactions under consideration can be magnetic and it is not surprising that the entire residue is attracted by the magnet. The magnetic susceptibility does not therefore invalidate the assumption of ferrous oxide being the catalyst.

Turning our attention now to the remedy suggested by the experiments with magnetite, it may be asked why this solution was chosen. Nesbitt and Bell[10] had previously recommended a hard firing for bricks to be used in the blast furnaces, for they found that iron is thereby left in a combination better able to withstand the disintegrating action of CO. Phelps' suggestion[28] for remedy was similar to the authors just mentioned. While it may be true that the iron is converted to iron silicate by hard firing, especially on the boundary surfaces between "iron spots" and the fire brick it is not at all unlikely that the $Fe_2O_3$ is converted to $Fe_3O_4$, since the latter is the stable phase at higher temperature. O'Harra and Darby[11] in their experiments with chromite bricks found that though these bricks contain much higher percentage of iron than fire bricks, the carbon monoxide has no disintegrating action on it. Seeing that chromite and magnetite are chemically similar, it was thought that magnetite would also resist action of carbon monoxide. The first qualitative run with a magnetite ore gave encouraging results, for it showed only a slight deposition of carbon (Table II).

As was anticipated, boats containing pure magnetite (Table V) showed very little alteration in weight and even this small variation may be due to inherent difficulties of analytical manipulation. The percentage of FeO in the samples used before and after experiment showed remarkable agreement, as is to be expected.

The conversion of $Fe_2O_3$ to $Fe_3O_4$ is a very delicate and difficult reaction. The data published by Hilpert and Bayer[18] are incomplete. The process had to be worked over almost anew. It was found that rate-of-flow and period-of-heating are very important factors, factors about which nothing or very little is mentioned by them. The reason why this method of preparation of magnetite was chosen in preference to others is that we must remember that the iron in the fire brick occurs

[26] *Compt. Rend.*, **149**, 342–45, (1909).
[27] *Compt. Rend.*, **184**, 674–76 (1927).
[28] *Jour. Amer. Ceram. Soc.*, **7**, 716–17 (1924).

as $Fe_2O_3$ and the conversion reaction must be such that it does not approach the fusing point of the refractory. Thus we are practically limited to this method.

Having found that magnetite is not affected by CO, the firebrick pieces were treated with hydrogen and water vapor as in conversion of $Fe_2O_3$ to $Fe_3O_4$ previously described.[29] The reactions in case of fire brick are more difficult to control.

The fire brick treated with hydrogen were then subjected to the action of carbon monoxide, the gas flowing at the rate of a liter per hour and at a temperature of 500°C. Even after prolonged action of carbon monoxide for more than fourteen hours the brick showed no swelling around "iron spots" and no disintegration. The result of gas analysis given in Table VII also shows that a very small percentage of carbon dioxide is formed. The highest amount recorded was only 1.6%, and even this small amount probably was formed by the combination of the little oxygen that was present in the original gas sample afterwards combining with the carbon monoxide.

## IV. Conclusions

From the foregoing results the following conclusions can be drawn:

(1) That the spots of ferric oxide in a fire brick are the points where disintegration of blast-furnace linings starts.

(2) That ferric oxide is reduced to ferrous oxide by carbon monoxide at 500°C and that the ferrous oxide is the catalyst which hastens the reaction $2CO \rightarrow CO_2 + C$, depositing carbon, the absorption of which by the linings, is the cause of their failure in service.

(3) That the oxide $Fe_3O_4$ is immune to such action.

(4) That by converting the $Fe_2O_3$ of the brick to $Fe_3O_4$, a brick is prevented from disintegrating.

(5) That this conversion is extremely difficult and that for the commercial success of the process, large-scale experimentation is still necessary.

**Acknowledgment** The authors gratefully acknowledge the coöperation of S. M. Phelps of the Mellon Institute of Industrial Research.

DEPARTMENT OF CHEMISTRY
UNIVERSITY OF PITTSBURGH
PITTSBURGH, PA.

[29] Patent applied for.

# SOME EFFECTS OF CAREFULLY ANNEALING OPTICAL GLASS[1]

By L. W. Tilton, A. N. Finn, and A. Q. Tool

ABSTRACT

The apparent lack of optical homogeneity in good optical glass may be the result of small differences in temperature during annealing. That this can be eliminated to a large extent by careful furnace control has been demonstrated. Furthermore, this may be done without appreciable change in the average index of refraction if the "thermo-optical" constants of the glass are predetermined.

## Introduction

It has been shown by investigators,[2] both in the United States and abroad that the index of refraction and other physical properties of glass are affected by the temperature at which the glass is annealed and also by the length of the holding period. As yet, however, little attention has been given to this aspect of the problem of annealing optical glass. This is largely due to the fact that the making of precision optical systems is still almost entirely unstandardized. Also the true magnitudes of the changes produced in glass by slight differences in heat history have not long been known. Recent quantitative measurements of these effects on refractivity,[3] including a quantity of unpublished data collected at the U. S. Bureau of Standards, show, however, that small differences in the effective treating temperature of the order of 1°C are quite sufficient to produce heterogeneities ranging from 20 to $50\times10^{-6}$ in refractivity, depending on the type of glass.

In annealing glass for optical components having large linear apertures, it is thus evident that furnace gradients may result in appreciable optical density variations within each piece. Consequently it may be inferred that in previous annealings some of the well-known defects in homogeneity of strain-free optical glass are due to this cause rather

[1] Publication approved by the Director of the National Bureau of Standards, Department of Commerce. A detailed treatment of this work is in press and will appear as Bureau of Standards, *Scientific Paper*, No. 572, entitled "Cause and Removal of Certain Heterogeneities in Glass." Presented at the Annual Meeting, American Ceramic Society, Atlantic City, N. J., February 1928. (Glass Division.) Received January 26, 1928.

[2] J. O. Reed, *Ann. d. Phys. u. Chem.* **65**, 707–744 (1898); A. Q. Tool and J. Valasek, Meeting Am. Phys. Soc., Balto., Md., 1918; Bur. Stand., *Sci. Paper*, No. 358, pp. 537–71 (1920); A. Q. Tool and C. G. Eichlin, *J.O.S.A.*, **4**, 340–63 (1920); C. G. Peters and C. S. Cragoe, Bur. Stand., *Sci. Paper*, No. 393, 449–87 (1920); A. A. Lebedeff, *Trans. Opt. Inst.* (Petrograd), **2** [10], 1–18, (1921); F. Twyman and F. Simeon, *Jour. Soc. Glass Tech.*, **7**, 199–207 (1923); A. Q. Tool and C. G. Eichlin, *J.O.S.A. & R.S.I.*, **8**, 419–49 (1924); Fritz Eckert, *Jour. Soc. Glass Tech.*, **9**, 267–72 (1925); A. Q. Tool and C. G. Eichlin, *Jour. Amer. Ceram. Soc.*, **8**, 11 (1925). A. A. Lebedeff, *Revue D'optique*, **5**, 1–30 (1926); *Die Glass Ind.*, **35**, 6–9 (1927).

[3] A. Q. Tool, L. W. Tilton, and E. E. Hill, Meeting Opt. Soc. Am., Ithaca, N. Y., 1925; Abs. in *J.O.S.A. & R.S.I.*, **12**, 490–91 (1926).

than to differences in chemical composition as has previously been supposed. As a result of such defects it is often necessary to employ local retouching of the optical surfaces to avoid irregularities in the transmitted wave-front. The extent to which they should be avoided varies, of course, with the care to be used in design and execution of a system. For the most exacting requirements it seems desirable that the maximum deviations from the mean index within a single lens blank should be confined to $\pm 0.000007$ divided by the thickness in centimeters, because under such conditions Rayleigh's one-quarter wave-length limit of aberration will probably not be exceeded on account of defective refracting media.

When, therefore, in selecting glass for some apochromatic objectives, it was found that six well-annealed barium flint blanks from the same melt showed deviations from the mean index[4] ($n_D = 1.568597$ at 25°C and 760 mm. pressure) which ranged from $+26 \times 10^{-6}$ to $-37 \times 10^{-6}$, it appeared possible that the heterogeneity within a given blank might easily exceed the above tolerance. This was partially confirmed when the index of a small prism from the periphery of one of the blanks proved lower by $7 \times 10^{-6}$ than the average for the whole disk.

## Experiments on Re-annealing

Viewing these interblank differences in the light of recent developments concerning the effects of heat history on the properties of glass and considering them also with reference to Eckert's[5] work on a similar glass, it seemed that inadequate heat treatment was a more probable cause than inadequate melting procedure. Consequently it was decided to reanneal the blanks in an electrically heated furnace, placing them between heavy iron plates to reduce the gradients in their vicinity and using a thorough preheating to decrease the differential effects of previous heat history. Heat treatment and index measurements on a small prism determined that treating temperature at which reannealing would produce little change in average index[6] and also yielded the "annealing equilibrium coefficient of index" which is $-0.00003$ per 1°C increase in treating temperature.

The schedule consisted essentially in preheating at 561°C for 3 hours and holding at 486°C for 13 days. Measurements then showed

[4] A spectrometer was used for all index measurements employing the minimum deviation method with all the precautions which experience has shown to be consistent with probable errors of a few units of the sixth decimal place.

[5] Fritz Eckert, *Zeits. f. Tech. Phys.*, No. 6, pp. 282–87 (1926).

[6] This method, employing index of refraction, is analogous to that previously mentioned for obtaining the same result by a number of heating curves. See A. Q. Tool and C. G. Eichlin, *Jour. Amer. Ceram. Soc.*, **8**, 15 (1925).

but one-third the previous range of deviation and an analysis of the data indicated that inadequate heat treatment did predominate in producing the heterogeneities both initially and after this first reannealing.

But it also appeared that a nonuniform furnace gradient averaging 0.4°C per 15 cm. existed during the reannealing and therefore some doubt remained about the uniformity of some of the blanks. Accordingly they were reannealed a second time, on a slightly changed schedule, with the added precaution of placing them in an aluminum box for the purpose of further reducing temperature gradients. As a result no deviation from the mean index exceeded $3\times10^{-6}$. The average index exceeded the initially measured value by only $17\times10^{-6}$, showing that the effective reannealing temperature had been reproduced within 0.6°C. Group averages still indicated the presence of a temperature gradient, but its magnitude was only one-sixth of that which existed during the first reannealing.

## Results

The results of this series of experiments are consistent therefore with the following conclusions: (1) Under conditions conforming to present good practice in production, differences in heat history cause optical density variations in practically strain-free glass which render its use questionable for the most exacting requirements.

(2) Such variations are largely removable by reannealing after a preheating, provided the furnace temperature gradients are sufficiently low.

(3) In properly selected glass, the maximum effects due solely to differences in chemical composition, if any exist, are small in the sixth decimal place of index of refraction.

## Discussion of Results

It is worthy of note that inequalities no larger than fractions of a degree in temperature distribution during annealing, which produce no significant effect on the condition of the glass so far as strain is concerned, are sufficient to cause defective performance when the glass is used in high precision optical systems. In properly made glass free from cords and striae, the predominance of these effects over those due to differences in chemical composition, while contrary to general opinion, is after all not surprising.

Fortunately, if defects are caused by heat treatment they are much easier to remedy or avoid than would be the case if they were caused by differences in composition. Consequently it now appears that high precision in telescopes, range finders, and other optical instruments

can be more easily reached than formerly because less of the skilled hand work will be required. In some instances it may even be possible to obtain an accuracy in optical measurements which has never before been realized. It appears also that the deleterious effects of small furnace gradients may be sufficient to completely mask the residuals of similar effects produced by the heat history preceding annealing. Thus better control of temperature gradients is necessary before it will be possible to investigate properly the important problems incident to annealing previously processed glasses, such as those which have been pressed or molded.[7] These problems must be solved whenever it is necessary to approach that true optical homogeneity of product which, in addition to mere freedom from strain, requires the highest degree of physico-chemical uniformity of structure or constitution.

[7] A. Q. Tool and C. G. Eichlin, *J.O.S.A.*, **4**, 360 (1920); *J.O.S.A. & R.S.I.*, **8**, 446 (1924).

# SOME FACTORS INFLUENCING THE THERMAL PROPERTIES OF MINERALS AND PRODUCTS OF THE CERAMIC INDUSTRY[1]

By Willi M. Cohn

(Translated from the German by Paul Mautz)

ABSTRACT

A survey is given of a number of factors which exert an influence upon the following thermal properties of several minerals and ceramic bodies: specific heat, thermal reaction, thermal conductivity, thermal expansion, thermal radiation, etc. The influences in the case of fired and unfired substances are differentiated. A bibliography is presented, which summarizes the work of recent years bearing on the thermal properties of minerals and ceramic bodies.

## Introduction[2]

Many investigations of recent years deal with the thermal properties of minerals and ceramic bodies; yet, for the most part, the data obtained from these tedious and difficult investigations are of little significance for practical use, since data are lacking, giving information under what conditions the materials were prepared and what was the chemical and physical nature of the substances in question.

There is an entire series of factors, which affect the thermal properties of minerals and ceramic bodies. These thermal properties will first be discussed and then the individual factors in their significance for fired and unfired materials.

## Thermal Properties

A. E. MacGee (91) has presented a paper on the thermal properties of ceramic materials, in which specific heats, thermal reactions, and thermal conductivity were taken up. By means of the determination of the magnitudes of the properties mentioned, it is possible to recognize transformations in the substances investigated, and to determine the heat balance of industrial kilns, etc.

Other properties are: (1) thermal expansion, which is the volume and length changes which bodies undergo on heating, and which may proceed either reversibly or irreversibly; and (2) thermal radiation. The last-named property is of significance in heat balances for industrial kilns, and plays a rôle in the estimation of the efficiency of firings. Unfortunately, up to this time relatively few experimental determinations have been made of the magnitude of thermal radiation, although in recent years the theory of the emission of solid bodies has been worked out very comprehensively.

---

[1] Presented at the Annual Meeting, American Ceramic Society, Atlantic City, N. J., February, 1928. (Refractories Division.) Received Jan. 25, 1928.

[2] For reference numbers in parentheses see Bibliography at end of paper.

## Factors, Which Influence the Thermal Properties of Unfired Materials

During the production of the raw materials (the preparation, shaping, drying, as well as the firing of the products, on the one hand, and the utilization of the manufactured products on the other hand) a series of influences affecting the minerals and products of the ceramic industry comes into play. These influences have a far-reaching effect upon the thermal behavior of these minerals and products. The factors which determine the behavior of unfired materials, when being heated for the first time are considered.

**Chemical Composition** The behavior of minerals and ceramic bodies on heating is largely determined by their chemical composition. Here appear, on the one hand, the reactions taking place within the individual constituents, and on the other hand, the opposing effects of the individual constituents upon each other on heating. To be sure, we may have to do with modification changes, crystallization processes, or other physical or chemical phenomena which are frequently associated with endothermic or exothermic thermal reactions. Exact investigations of the thermal expansion as well as of the specific heats in relation to temperature, make possible the detection of thermal reactions when they do not produce too small effects or proceed too slowly. Compare here especially the work of the author (12), as well as the investigations of MacGee (92) and Simpson (100). The behavior of the most important materials of the ceramic industry on heating is briefly summarized as follows:

Quartz shows a number of reactions on heating, which have been investigated in numerous experiments. Expansion measurements have been made, for instance, by Holborn, Scheel, and collaborators (2), Houldsworth and Cobb (8), Steinhoff (107), Travers and de Goloubinoff (77), Hirsch (60), likewise in several experiments by Steger (35, 36, 37, 50, 51, 104, and 105) and Endell and Steger (56). From the last-mentioned article are taken Tables I and II,[3] which compile the linear changes during the transformations of different silicic acid modifications.

For the heating of the cations of the different quartz modifications, the tables show a series of reversible and irreversible effects. The reversible phenomena appear on each heating of the material, and on cooling again disappear in inverse order; so that they appear in fired and unfired bodies, which are repeatedly heated. On the other hand, the irreversible effects appear only on the first heating of the unfired material, and no longer manifest themselves on later heatings, as long as this later heating proceeds sufficiently far below the preliminary

[3] See *Glastech. Berichte*, **4**, 49 (1926) Tables I and II.

firing temperature. We shall return to this in the next section on the treatment of silicate rocks.

The transformation phenomena of quartz and its modifications may also be recognized from the determinations of the specific heats; the heat tones also give us this information, as the investigations of W. M. Cohn (11 and 12) and MacGee (64) have shown. On the contrary, up to this time we have not succeeded in determining the effects of transformation phenomena in measurements of thermal conductivity.

Feldspar shows irregularities on heating in the region 550 to 600°C, as the expansion measurements of Geller (83) have shown: however no confirmation of this discovery has been made from other measurements.

Clays give on the first heating in general a series of sharply distinguished transition-points, which have been expressed in the curves of the specific heats in the work of W. M. Cohn (11 and 12), MacGee (91) and Simpson (100). In the expansion determinations of all clays a permanent shrinkage or expansion occurs. (Compare the compilation in the International Critical Tables (108). The work on the expansion behavior of finished products on heating will be given in the next section.)

**Height of the Firing Temperature**

The height of the firing temperature is determined by the use which is to be made of the product being manufactured. The object is to fire a product at as low a temperature as possible, in order to conserve heat. The magnitude of the heat requirement depends upon the specific heats of the material in question, and upon the amounts of heat incorporated in or developed by the thermal reactions occurring. At the present time we have investigations of the specific heats and heat tones for most minerals and ceramic bodies which give a good survey of the heat requirement. Compilations are found in the following articles: Singer (21 and 75), Hougen (27), Green (42), Steger (105), MacGee (65), International Critical Tables (108), Landolt-Börnstein (90).

**Duration of Heating**

In addition to the height of the firing temperature there is another factor which is frequently ignored in thermal investigations, that is, the duration of heating. Unfortunately only a very few isolated articles bear on this subject: Steinhoff (22), also Dale (25). The last-mentioned work has for its object the investigation of the expansion or the behavior during heating under load.

**Heating and Cooling Velocity**

A further factor, which is to be considered in thermal investigations, is the magnitude of the heating and cooling velocity. Here also but a few investigations have been made. Some data appear in the work of the author on

specific heats (11 and 24); an investigation of the thermal expansion of refractory materials by Houldsworth (29) furnishes some data, and shows especially the influences at work in the formation of cristobalite and tridymite at higher temperatures. The effect of the velocity of heating and cooling upon thermal conductivity has, on the contrary, not yet been investigated.

The time factor for all values for thermal properties is determined in the laboratory with small amounts of material and large heating velocities, whereas in kilns there are large amounts of material and small heating velocities. In this way it is possible to explain that in practice in many instances the reaction temperatures are suppressed and the heat requirement decreased, so that more favorable efficiencies are obtained in the ceramic kilns than in laboratory investigations. Compare also the communication of W. M. Cohn and MacGee (80).

**Resistance Capacity toward Temperature Change**

Of the articles on the determination of the resistance capacity of refractory materials toward temperature change, reference will be made here only to the work of Steger (51), since this gives an exceptional survey of the effect of this factor on differently constituted refractory bodies. This work is in general a confirmation of the older investigations of Houldsworth and Cobb (8 and 16).

**Different Physical Factors**

As yet no investigations for ceramic materials are at hand on the effect of pressure increase or pressure decrease in the interior of the kilns, although proposals in this direction for glass furnace have frequently been made. See, for instance, the work of Washburn, Footitt, and Bunting (4). It is to be perceived, that a change in pressure in the firing of ceramic materials will exert a favorable effect upon the fuel requirement of the kilns and upon the properties of the product.

### Factors Which Affect the Thermal Properties of Fired Materials

A material, fired once, shows properties on reheating which are significantly different from those of the first heating. The investigation of specific heats has furnished confirmation of the vant Hoff-Thompson rule, according to which the modification stable at a higher temperature has a larger specific heat than the modification stable at a lower temperature. Ceramic materials have a higher specific heat in the fired state than in the unfired state.

**Height of the Firing Temperature and Duration of Heating**

A simple relationship was obtained between the height of the firing temperature and the duration of heating of silicate rocks, and their specific gravity. It was shown that rocks having a specific gravity higher than 2.40 still contained rather

large amounts of quartz, which goes to show that the rocks were not fired sufficiently high, or sufficiently long. In Fig. 1, taken from the work of Steinhoff (22 and 107) the thermal expansion curves of different silicate rocks are repeated according to Middleton. From these curves the effect of the firing temperature may be clearly recognized. Figure 2 from International Critical Tables (108) shows the permanent expansion of silicate rocks in relation to specific gravity according to Endell and Steger (56). Here also it is possible to determine very well from the curves, whether the rocks in question have been fired at a sufficiently high temperature and sufficiently long.

Whereas in the case of a sufficiently highly fired material the thermal expansion becomes reversible on repeated heating, it is possible, for instance, in the case of materials which are reheated to temperatures higher than their firing temperature, to set up an after-shrinkage, which results in irreversible length and volume changes. A similar phenomenon may be observed, if the materials are held for a long time at temperatures slightly below their first firing temperature.

In an investigation of the Bureau of Standards (78) large differences were found in the thermal expansions of different refractories which have been made by the same manufacturer in the same fire.

Also, in other ceramic products a series of transition points have been observed on reheating. These transition points are attributed to transformations, etc. These transition points were investigated especially thoroughly with the aid of expansion measurements. The experiments of Tadokoro (9), Norton (69), and Steger (51), show, on the one hand, the effect of the composition of the bodies, and on the other hand, the effect of the fire.

Other thermal investigations, such as measurements of the specific heats and the thermal conductivities, have previously been conducted only in very slight degree with systematic consideration of the factors of chemical composition and the height of the firing temperature. Yet such investigations should furnish further conclusions with respect to the thermal behavior of minerals and products of the ceramic industry.

**Repeated Firing** Attention has already been called to the effect of repeated firing of silicate rocks. The work by Kieffer (89) shows the effect of repeated firing on the expansion behavior of different quartz-containing sagger bodies. He found a definite end state was only attained when no more untransformed or undissolved quartz could be observed. Green (15 and 42) investigated the effect of repeated heating on the conductivity of refractory materials which had been in use for 18 years in a coke-oven wall. Increases in the thermal conducitivity of the used material over the unused rock ranged from 10 to 22%.

**Porosity** A factor, which plays a part in all thermal properties of ceramic products is porosity, which is expressed as specific volume. Thermal conductivity decreases with increasing pore content because the air within the substance increases with increasing pore content, and the thermal conductivity of air has the small value of 0.02 Cal., which is significantly smaller than the value of the thermal conductivity for ceramic materials. Investigations on this point have been made by Cammerer (39) and Tadokoro (76).

Porosity has an important effect on thermal expansion. The work of Tadokoro shows a decrease in expansion with increasing pore content. Further references to this factor are found in the work of Geller and Heindl (57), E. H. Schulz (73), and Houldsworth and Cobb (16).

The effect of porosity upon the specific heat has been but little investigated up to the present; only the work of Tadokoro (9) should be mentioned here. He found that a decrease of the values for the specific heats occurs with increasing pore content. A minimum lies between 37 and 38% pore content; then an increase of the values again occurs.

**Grain Size and Texture** The effects of the grain size upon thermal expansion were clearly shown in the work of Steger (35, 36, 37, 50, 51, 104, and 105). It is to be expected that the grain size will also play a considerable rôle in the thermal conductivity and specific heat of minerals and ceramic bodies. Unfortunately, no systematic investigations on this point are yet at hand.

Jakob (17) has investigated the effect of the structure of the experimental body, whether crystalline or amorphous, on the thermal conductivity. This investigation indicates the great effect of the structure factor. Investigations by Green (14) deal with the effect of the content of previously-fired material upon the thermal conductivity. The other thermal properties might also be affected by these factors.

**Pressure Increase** Bridgman (5 and 23) investigated the relationship of thermal conductivity and pressure, and found that the thermal conductivity increases with increasing pressure. His values show, further, the effect of temperature upon thermal conductivity at elevated pressures.

**Moisture Content** An increase in the thermal conductivity of moist materials may be attributed to the filling of the pores with moisture, and the displacement of the air which is a very poor conductor of heat. This behavior is plainly shown in the compilations of Schmidt (33) and Cammerer (39).

The effect of the moisture content upon the thermal properties other than conductivity ought not to be of much significance.

**Nature of the Surface**

The nature of the surface plays an especially important rôle in the thermal radiation of minerals and ceramic materials. It has been shown that the emission from a rough surface at a given temperature is greater than the emission from smooth or glazed surfaces. Reference is made here especially to the experiments of Nusselt, Sigl, Wamsler, Westphal, and Jürges, which are compiled in the Hütte (45); also to the investigations of Polak (95); also a reference is found in the work of Green (42) to the magnitude of thermal radiation.

An experimental investigation is yet lacking as to how nearly the radiation of our materials at high temperatures approaches that of a black body, and how closely it follows the laws there effective.

**Behavior under Load**

A very important indication of the value of refractory rocks is their behavior under load at high temperatures. Reference is here made to the investigations of Endell and collaborators (40 and 56), Dale (13 and 25), and Hirsch (60), which give a survey of most of the materials used in the ceramic industry.

## Summary

An entire series of factors plays a rôle in the determination of the thermal properties of minerals and ceramic bodies. The determination of the numerical values for the individual thermal properties must therefore be undertaken with regard to these factors. In all experimental investigations there should be stated what physical and chemical conditions are manifested in the materials investigated.

KAISER-WILHELM-INSTITUT FUR
SILIKATFORSCHUNG
BERLIN-DAHLEN

## Bibliography

1919

(1) L. Bradshaw and W. Emery, "The Specific Heats of Refractory Materials at High Temperatures," *Trans. Ceram. Soc.* [Eng.], **19**, 84–92 (1919–20).
(2) L. Holborn, K. Scheel, and F. Henning, Heat Tables of the Physical-Technischen Reichsanstalt, Braunschweig, Vieweg, 1919.
(3) W. P. White, "Specific Heat Determinations at Higher Temperatures," *Sill. Jour.*, No. 47 (1919).

1920

(4) E. W. Washburn, F. F. Footitt, and E. N. Bunting, "Dissolved Gases in Glass," Univ. Illinois, *Bull.*, No. 18, p. 15 (1920).

1921

(5) P. W. Bridgman, "The Effect of Pressure on the Thermal Conductivity of Metals," *Proc. Amer. Acad.*, 57, 77–127 (1921–22).
(6) A. T. Green, "The Thermal Conductivity of Refractory Materials at High Temperatures," *Trans. Ceram. Soc.* [Eng.], **21**, 394 (1921–22).
(7) H. Gröber, The Basic Laws of Thermal Conductivity and Thermal Transition, Berlin: Springer (1921).
(8) H. S. Houldsworth and J. W. Cobb, "The Reversible Thermal Expansion of Silica," *Trans. Ceram. Soc.* [Eng.], **21**, 227 (1921–22).

(9) Y. Tadokoro, "On the Determination of the Thermal Conductivity, Specific Heat, Density and Thermal Expansion of Different Rocks and Refractory Materials," Tohoku Imp. Univ., *Sci Repts.*, **10**, 339–410 (1921).

1922

(10) A. T. Green, "The Specific Heat of Magnesite Brick at High Temperatures," *Trans. Ceram. Soc.* [Eng.], **22**, 393 (1922–23).

1923

(11) W. M. Cohn, Contribution to the Question of Heat Economy in the Ceramic Industry, Dissertation: Berlin T. H., 1923.
(12) W. H. Cohn, "Contribution to the Question of Heat Economy in the Ceramic Industry," *Ber. d. Keram. Ges.*, **4**, 53–57 (1923).
(13) A. J. Dale, "The Relation between Underload Refractoriness, Ordinary Refractoriness, and Composition, Physical and Chemical, of Refractory Materials," *Trans. Ceram. Soc.* [Eng.], **23**, 217 (1923–24), **24**, 170 (1924–25).
(14) A. T. Green, "The Influence of Texture on the Transmission of Heat through Fire Bricks," *Trans. Ceram. Soc.* [Eng.], **23**, 233 (1923–24); *Gas Jour. Supp.*, p. 31 (1924).
(15) A. T. Green, "The Thermal Conductivity and Some Other Properties of Two Commercial Heat Insulating Bricks Used in Kiln Construction," *Trans. Ceram. Soc.* [Eng.], **23**, 271–76 (1923–24).
(16) H. S. Houldsworth and J. W. Cobb, "The Reversible Thermal Expansion of Refractory Materials," *Jour. Amer. Ceram. Soc.*, **6**, 645 (1923).
(17) M. Jakob, "Structure and Heat Conducting Power of Refractory Rocks," *Z. Ver. d. Ingen.*, **67**, 126–27 (1923).
(18) L. Navias, "Measurement of the Heat Absorbed and Evolved by Clays during Firing and Cooling," *Jour. Amer. Ceram. Soc.*, **6** [12], 1268–98 (1923).
(19) R. Rieke, "The Properties and Testing of Refractory Substances," *Gas u. Wasserfach*, **66**, 33, 53, 66 (1923).
(20) E. Schmidt, "A New Device for Measuring Heat Flow and Its Practical Significance in Insulation Technology," *Mitt. Forschungsh. Wärmeschutz*, No. 3 (1923).
(21) F. Singer, Ceramics in the Service of Industry and Political Economy, Braunschweig: Vieweg, 1923.
(22) E. Steinhoff, "Investigations on Silica Rocks," *Werkstoffausschussber.*, 39, 1923.

1924

(23) P. W. Bridgman, "The Thermal Conductivity and Compressibility of Several Rocks under High Pressure," *Amer. Jour. Sci.*, **7**, 81–102 (1924).
(24) W. M. Cohn, "The Problem of Heat Economy in the Ceramic Industry," *Jour. Amer. Ceram. Soc.*, **7**, 359–76, 475–88, 548–62 (1924).
(25) A. J. Dale, "An Investigation of the Effects of Load, Temperature, and Time on the Deformation of Firebrick Material at High Temperatures," *Trans. Ceram. Soc.* [Eng.], **24**, 199–215 (1924–25).
(26) M. D. Hersey and E. W. Butzler, "Determination of Thermal Conductivity of Refractories," *Jour. Wash. Acad. Sci.*, **14**, 147–51 (1924).
(27) O. A. Hougen, "Selection Factors in Choosing Refractories for Industrial Plant Use," *Chem. Met. Eng.*, **30**, 737–41 (1924).
(28) H. S. Houldsworth and J. W. Cobb, in Searle, The Chemistry and Physics of Clays and Other Ceramic Materials. London: Benn (1924).
(29) H. S. Houldsworth, "Note on the Influence of Rapid Cooking on the Reversible Expansion of Fire Clay, I," *Jour. Soc. Glass Tech.*, **8**, 30–38 (1924).
(30) S. Kozu, "The Thermal Expansion of Quartz and Adularia," Japan, *Jour. Astron. and Geophys.*, **2** [2], (1924).
(31) G. E. Merritt, "Application of the Interferometer to Measurements of the Thermal Dilatation of Ceramic Materials," Bur. Stand., *Sci. Papers*, **19**, No. 485, p. 357 (1924).
(32) A. Schack, "Recent Developments in the Field of Heat Radiation," *Z. Ver. d. Ingen.*, **68**, 1017–20 (1924).
(33) E. Schmidt, "The Thermal Conductivity Values of Substances on the Basis of Measured Results," *Mitt. Forschungsh. Wärmeschutz*, No. 5 (1924).
(34) K. Schultz, "The Thermal Conductivity of Minerals, Rocks, and the Artificially Prepared Substances of Corresponding Composition," *Fortschr. Min.*, etc., **9**, 221–411 (1924).

(35) W. Steger, "Investigations on the Determination of the Causes of Excessive Sagger Breakage," *Ber. d. keram. Ges.*, **5** [3], (1924).
(36) W. Steger, "On the Present Status of Our Knowledge of the Resistivity toward Temperature Change of Refractory Substances in Metallurgy," *Werkstoffausschussber.*, 52 (1924).
(37) W. Steger, "The Significance of the Thermal Expansion Coefficients for the Stability of Ceramic Bodies and Their Raw Materials toward Temperature Change," *Sprechsaal*, **57**, No. 26 (1924).

1925

(38) Amos, "Testing of Walls for Insulation and Fire Durability," *Tonind. Ztg.*, **49**, 201–205 (1925).
(39) J. S. Cammerer, "On the Connection between Structure and Thermal Conductivity Values for Construction and Insulating Materials, and the Effect of Moisture Content upon These Factors," *Mitt. Forschungsheim Wärmeschutz München*, No. 4 (1925).
(40) K. Endell and R. Harr, "The Effect of Oxide Additions on the Physical Properties of Silica Rocks" *Werkstoffausschussber.*, No. 79 (1925).
(41) A. T. Green, "The Effect of Industrial Usage on the Thermal Conductivity of a Semisilica Material Used in a Coke-oven Wall," *Trans. Ceram. Soc.* [Eng.], **25**, 258 (1925–26).
(42) A. T. Green, "The Thermal Properties of Refractory Materials and a Consideration of the Factors Influencing Them," *Trans. Ceram. Soc.* [Eng.], **25**, 361–85 (1925–26).
(43) M. D. Hersey and E. W. Butzler, "Conductivity and Specific Heat of Refractories at High Temperatures," *Ceramist*, **5** [1], (1924); *Feuerfest*, **1**, 91 (1925).
(44) H. Hirsch and M. Pulfrich, "A New Process for the Determination of Expansion in the Higher Temperature Range," *Tonind. Ztg.*, **40**, 452–53 (1925).
(45) Hütte, Vol. I, 25th ed. Berlin: Ernst & Sohn, 1925.
(46) A. Kanz, "Investigations on the Heat Conducting Power of Refractory Materials," *Werkstoffausschussber.*, No. 78 (1925).
(47) S. Kozu and S. Saiki, "The Thermal Expansion of Alkali-Feldspars," Tohoku Imp. Univ., *Sci. Repts.*, **2**, 203–38 (1925).
(47*a*) L. Litinsky, Clay and Silica Brick. Leipzig. Spamer 1925.
(48) F. Neumann, "On the Stability Ratios of the Modifications in the Polymorphic System $Al_2SiO_5$," *Z. Anorg. Chem.*, **145**, 193–285 (1925).
(49) E. Schmidt and A. Grossman, "Investigations on the Heat Insulation of Construction Materials," *Mitt. Forschungsh. Wärmeschutz*, No. 4, 1925.
(50) W. Steger, "An Apparatus for the Indication of the Thermal Expansion of Ceramic Materials," *Sprechsaal*, **58**, No. 48 (1925).
(51) W. Steger, "The Resistivity of Refractory Materials toward Temperature Change," *Stahl u. Eisen*, **45**, 249 (1925).
(52) J. F. L. Wood, H. S. Houldsworth, and J. W. Cobb, "The Influence of Foreign Matter on the Thermal Expansion and Transformation of Silica," *Trans. Ceram. Soc.* [Eng.], **25**, 289–308 (1925–26).

1926

(53) K. Becker, "An X-ray Method for the Determination of the Thermal Expansion Coefficients at High Temperatures," *Z. Phys.*, **40**, 37–41 (1926).
(54) W. M. Cohn and A. E. MacGee, "On the Specific Heats and Heat Tones of Clays, etc.," *Ber. d. Keram. Ges.*, **7**, 149–55 (1926).
(55) K. Endell and E. Pfeiffer, "On the Constitution of Silica Coke-oven Rocks," *Werkstoffausschussber.*, No. 91 (1926).
(56) K. Endell and W. Steger, "On the Temperature Sensitivity of Refractory Rocks in the Glass Industry," *Glastech. Ber.*, **4**, 43–57 (1926).
(57) R. F. Geller and R. A. Heindl, "Progress Report on Investigation of Sagger Clays, Some Observations as to the Significance of Their Thermal Expansions," *Jour. Amer. Ceram. Soc.*, **9**, 555–74 (1926).
(58) H. Gröber, Introduction to the Study of Heat Transfer. Berlin: Springer (1926).
(59) M. L. Hartmann and O. B. Westmont, "The Thermal Conductivity of Carborundum Refractories," *Trans. Amer. Electrochem. Soc.*, **46**, 485 (1926); *Jour. Amer. Ceram. Soc.*, **8**, 342–45 (1927).
(60) H. Hirsch, "Behavior of Silica Rock under Pressure Softening and Expansion Experiments," *Werkstoffausschussber.*, No. 93, 1926.

(60*a*) H. Hirsch, "The Effect of Silicic Acid in Ceramics," *Keram. Fachgruppe im. D. Hauptverband Ind.*, Aussig No. 7 (1926).
(60*b*) H. Hirsch, "The Effect of the Different Forms of Silicic Acid in Porcelain Bodies," *Ber. d. keram. Ges.*, **7**, 49 (1926); *Keram. Runds.*, **34** [43] (1926).
(61) M. Jakob, "Heat Conduction," *Handb. Phy. Geiger-Scheel*, **11**, 42–155 (1926).
(62) F. Kanhäuser, "On High Temperature and Heat Enduring Materials in Science and Practice," Ceramic Professional Group on D. Hauptverband Ind. Aussig, No. 4 (1926).
(63) B. Kleinschmidt, "A New High Refractory Substance," *Centralbl. Hütten u. Walzwerke*, **30**, 79–81 (1926).
(64) A. E. MacGee, "The Heat Required to Fire Ceramic Bodies," *Jour. Amer. Ceram. Soc.*, **9**, 206–47 (1926); *Ber. d. keram. Ges.*, **7**, 146–48 (1926).
(65) A. E. MacGee, "The Rôle of Specific Heat in the Selection of Refractories," *Jour. Amer. Ceram. Soc.*, **9**, 374–79 (1926).
(66) G. E. Merritt, "The Thermal Expansion of Some Fused Oxides Used as Refractories, "*Trans. Amer. Electrochem. Soc.*, **50**, 283 (1926).
(67) G. E. Merritt and C. G. Peters, "Interferometer Measurements of the Thermal Dilatation of Glazed Ware," *Jour. Amer. Ceram. Soc.*, **9**, 327–42 (1926).
(68) W. Miehr, H. Immke, and I. Kratzert, "The Specific Heats of Our Refractory Rocks in Their Relation to Temperature," *Tonind. Ztg.*, **50**, 1671–74, 1791–93 (1926).
(69) F. H. Norton, "The Thermal Expansion of Refractories," *Jour. Amer. Ceram. Soc.* **8**, 799 (1925); Discussion in *Bull. Amer. Ceram. Soc.*, **5**, 215–17 (1926).
(70) E. Raisch, "On the Calculation of the Thermal Conductivity Values of Porous Bodies," *Mitt. Forschungsheim Wärmeschutz*, No. 7 (1926).
(70*a*) H. Salmang, "On the Softening Test for Refractory Materials," *Sprechsaal*, **60**, 477 (1926).
(71) K. Scheel, "Specific Heats," *Experimental Part. Handb. Phys. Geiger-Scheel*, **10**, 321–49 (1926).
(72) A. Schlüter, "Heat Flow in Walls for Periodically Variable Temperature of One Surface," *Mitt. Wärmestelle Fachausschussber.*, No. 83 (1926).
(73) E. H. Schulz, "Refractory Materials, Their Testing and Their Behavior in Metallurgy," *Stahl u. Eisen*, **46**, 1667-68 (1926).
(74) W. L. Shearer, "Zirconia as a Constituent of Ceramic Bodies," *Ceramist*, **5**, 316 (1925); *Glastech. Ber.*, **4**, 155 (1926).
(75) F. Singer, "Progress of Ceramics and Its Significance for the Chemical Industry," *Z. Anorg. Chem.*, **40**, 1273 (1926).
(76) Y. Tadokoro, "On the Effect of Porosity upon Thermal Conductivity, Diffusivity, and Heat Capacity at High Temperatures," Tohoku Imp. Univ., *Sci. Repts.*, **15**, 567–96 (1926).
(77) Travers et de Goloubinoff, "Contribution to the Works of Silica Brick," *Rev. Met.*, **23**, 27–57, 100–117 (1926).

**1927**

(78) Anon., "Thermal Expansion of Clays and Special Refractories," Bur. Stand., *Tech. News Bull.*, No. 117, pp. 2–3 (1927).
(79) H. N. Baumann, Jr., "The Heat Balance Study of Ceramic Kilns," *Jour. Amer. Ceram. Soc.*, **10** [11], 860–96 (1927).
(79*a*) M.ten Bosch, Heat Transfer. Springer, Berlin, 1927.
(79*b*) J. S. Cammerer, "A New Small Laboratory Apparatus for the Measurement of the Thermal Conductivity Value of Dry Insulating and Construction Materials," *Messtechnik*, **3**, 253–58 (1927).
(80) W. M. Cohn and A. E. MacGee, Discussion on "Specific Heats and Thermal Reactions of Clays, etc.," *Jour. Amer. Ceram. Soc.*, **10**, 347–56 (1927).
(81) Demuth, Steatite, VDI, *Nachr.*, **7** [42], 13 (1927).
(82) K. Endell, "Recent Reviews on the Use of Refractory Materials in the Metal Industry," *Met. u. Erz*, **15**, 225–30 (1927).
(83) R. F. Geller, "Bureau of Standards Investigation of Feldspar," *Jour. Amer. Ceram. Soc.*, **10**, 411–34 (1927).
(83*a*) R. F. Geller, "The Importance of the Elasticity and Thermal Expansion of Refractory Clays and Their Influence on the Spalling of the Fired Product," *Feuerfest*, **4**, 6–9 (1928); Amer. Refrac. Inst., *Tech. Paper*, No. 4 (1927).
(84) H. Handrek, "Porcelain as a Working Material," *Z. Ver. d. Ingen.*, **71**, 1553–60 (1927).

(85) F. Hartmann, "Refractory Materials for Boiler and Kiln Construction," *Heat Economy*, etc., **8**, 342–45 (1927).
(85*a*) H. Hirsch, "The Properties of the Magnesite Rocks," *Arch. Eisenhüttenwes.*, **1**, 439–44 (1927).
(86) B. M. Johnson and J. A. King, "The Use of Silicon-Carbide Refractories in Boiler Furnaces," *Jour. Amer. Ceram. Soc.*, **10**, 1007–15 (1927).
(87) H. Kornfeld, "On the Question of the Temperature Course and the Heat Flow in Periodically Heated Walls with Variable Heat Conductivity," *Z. Tech. Phys.*, **8**, 178–83 (1927).
(88) E. Kothny, "Refractory Materials for the Electrical Steel Kiln," *Feuerfest*, **3**, 157–64 (1927).
(89) E. Kieffer, "On the Thermal Expansion Behavior of Quartz-containing Sagger Raw Materials," *Ber. d. Keram. Ges.*, **8**, 73–92 (1927).
(90) Landolt-Börnstein, Physical-Chemical Tables, 5th ed. Berlin, Springer, 1923, 1927.
(91) A. E. MacGee, "Some Physical Properties of Chemical Stoneware Bodies," *Jour. Amer. Ceram. Soc.*, **10**, 569–78 (1927).
(92) A. E. MacGee, "Some Thermal Characteristics of Clays," *Jour. Amer. Ceram. Soc.*, **10**, 561–68 (1927).
(93) W. Miehr, H. Immke, and I. Kratzert, "The Significance of Thermal Expansion for the Estimation of Refractory Materials," *Tonind. Ztg.*, **51**, 417–22 (1927).
(94) F. H. Norton. "The Thermal Conductivity of Some Refractories," *Jour. Amer. Ceram. Soc.*, **10**, 30–52 (1927).
(95) V. Polak, "Experiments on the Determination of the Radiation Values of Solid Bodies," *Z. Tech. Phys.*, **8**, 307–312 (1927).
(96) E. Raisch, "Critical Survey of the Process of Testing for Thermal Conductivity Values," *Arch. Wärmewirtsch.*, **8**, 133–37 (1927).
(97) A. Schack, "Practical Calculation of Temporary Variable Heat Currents," *Arch. Eisenhüttenwesen*, **1**, 357–70 (1927).
(98) K. Schönert, "The Thermal Expansion of Refractory Materials," *Arch. Eisenhüttenwesen*, **1** [5], (1927).
(99) W. L. Shearer and W. B. Wyckoff, "Thermal Expansion of White Ware Materials and Bodies over a Wide Temperature Range," *Ceramic Age*, **7**, 349 (1927); *Sprechsaal*, **60**, 54, 385 (1927).
(100) H. E. Simpson, "The Heat Required to Fire Ceramic Bodies," *Jour. Amer. Ceram. Soc.*, **10**, 897–918 (1927).
(101) F. Singer, "Stoneware as a Working Material in Electrical Technology," *Elektro-Jour.*, (19) (1927).
(102) F. Singer, "Stoneware as a Working Material," *Z. Ver d. Ingen.*, **71**, 122 (1927).
(103) A. Sommerfield, "On the Electron Theory of Metals," *Naturw.*, **15**, 825–32 (1927).
(104) W. Steger, "New Investigations on the Thermal Expansion and Annealing Temperature of Glazes (with Especial Regard to the Fitting of the Glaze to the Bodies)," *Ber. d. Keram. Ges.*, **8**, 24–43 (1927).
(105) W. Steger, Heat Economy in the Ceramic Industry, Dresden and Leipzig: Steinkopff 1927.
(106) E. Steinhoff, "On Modern Methods of Investigation of Refractory Materials and Their Significance in Gas Producer Construction," *Tonind. Ztg.*, **51**, 918, 1011, 1047 (1927).
(107) E. Steinhoff, "The Significance of Silicic Acid Transformation for the Firing Process and for the Behavior of Refractory Rocks in Operation," *Keram. Rund.*, **35**, 368, 387, 402 (1927).
(108) International Critical Tables, II. N. Y.: McGraw-Hill Book Co. (1927).

1928

(109) W. M. Cohn, "On Expansion Coefficients of Zirconium Oxide," *Ber. d. Keram. Ges.*, **9** [1], (1928).
(110) M. Jakob, "Heat Transfer," *Z. ver. d. Ing.*, **72**, 341–44 (1928).
(111) W. Miehr, J. Kratzert, and H. Immke, "Contribution to the Determination of the Sensitivity to Temperature Change of Refractory Materials," *Tonind. Ztg.*, **52**, 56–60, 77–78 (1928).
(112) W. Miehr, J. Kratzert, and H. Immke, "The Influence of the Firing upon the Chemical and Physical Properties of Refractory Clays," *Tonind. Ztg.*, **52**, 280–82, 298–301, 323–25 (1928).
(113) F. Singer, "Fused Quartz," *Keramos*, **7** [4] (1928).

# ACID-RESISTING OVERGLAZE COLORS[1]

By R. V. Tailby

ABSTRACT

There is great demand for overglaze colors which are resistant to the action of acids and alkalis. Difficulties encountered in the production of such colors are mentioned. Requirements to be met are enumerated. Experimental evidence of acid-resistance is discussed, and a provisional test known as the "immersion test" is described.

## Introduction

Lavish decoration is the theme of the day, and color is its medium. Especially is this true of ceramic products made to meet the popular demand. We see increased use of color on every side and manufacturers of all types of ceramic wares hastening to meet the day's vogue.

But along with this demand for decoration comes a demand for durability, a demand for better service, and manufacturers find themselves forced to raise the quality of their products to meet competition and keep their factories running. Especially may this condition be noted among producers of glass of various types and among producers of enameled ware, who are all striving for ware more resistant to the chemical action of various agents to which the products will be subjected in daily use. This situation marks the genesis of a demand for overglaze colors resistant to the action of acids and alkalis.

A great amount of work has been done during the past two or three decades on developing a series of acid-resistant overglazes, but, until recently, with little success. The chief difficulty has been to produce overglaze colors that would fire to a gloss at the usual decorating heat, and maintain this gloss after being subjected to the action of acid solutions, or the repeated action of cleaning solutions encountered in daily use.

A palette of resistant overglaze colors is of the greatest importance where mechanically operated dishwashers are in use. Customary procedure in washing dishes is to stack them in a wooden rack and sprinkle a generous portion of cleaning powder over them. The rack of dishes is then placed in a chamber where the ware is subjected to the action of hot water and steam. The chemical action of these caustic, and in some cases, acid-cleansing solutions, as well as the action of the hot water and steam, causes a gradual disintegration of the overglaze colors ordinarily employed. Certain foodstuffs also play an important part in the disintegration of overglaze colors.

Acid proof colors are also important on terra cotta. Muriatic acid is sometimes used in cleaning terra cotta, and by the substitution of an

---

[1] Presented at Annual Meeting, American Ceramic Society, February 1928, Atlantic City, N. J. (White Wares Division.)

acid-resistant color for an ordinary overglaze, greater durability of the color is assured. It is possible to produce colors on terra cotta of great brilliancy by means of overglazes; also certain colors not possible to produce at a regular terra cotta heat, but which can be obtained at a decorating heat.

The requirements to be met are considered to be the following:

(1) The expansion coefficient must closely approximate that of the glaze used on the ware.

(2) A temperature of maturity at not more than cone 017 down.

(3) No difference in application of these colors, particularly for decal work.

(4) A rigid test for acid and alkali resistance, which must leave the surface of the overglaze color unimpaired, and must not interfere with the gloss.

It has been the usual view that acid resistance is a function of $SiO_2$ content. The work done on this problem, however, has disproved that idea, and it has been found that there are certain limits within which the maximum resistance is obtained, and that if these limits are exceeded, acid-resistant properties are diminished.

## Experimental Evidence

**Definition of "Acid Resistance"**

A simple test to determine the limit of endurance is of the greatest importance. The method used must be of such a nature as to approximate in a very short time the results of actual service.

There are two ways open: (1) qualitative: the fired-on colors are immersed in a standard testing solution, the action of which is observed and compared by visual inspection; and (2) quantitative: the weight of fired-on color is determined, subsequent immersion in a standard testing solution for a stated time, and then determining the quantitity of lead extracted from the color and contained in the solution.

The latter method has certain obvious disadvantages, and for all practical purposes, is of no particular value, especially where there is such a great difference in solubility between the ordinary and this new line of overglaze colors.

The chemical agents selected as the best test mediums are 4% acetic acid, 3% hydrochloric acid, and 5% caustic soda solution. Several overglaze colors were subjected to this test, and after a very short time showed evidences of disintegration, while others showed no loss of gloss.

It was concluded from the results of our investigations that acid and alkali resistance may be made to go hand in hand, and we term these

overglaze colors, which are both alkali- and acid-resistant, as a class "acid-resistant overglazes."

From quantitative tests, it has been found that the lead solubility of the ordinary overglaze colors is from 10 to 100 times as large as that of acid-resisting colors, and at the end of a 10-hour treatment with 3% HCl the ordinary overglaze colors are almost decomposed while the amount of lead extracted from the same amount of acid-resistant color is less than .001 g.

As a standard procedure we have provisionally selected a test which has been christened the "immersion test," consisting of immersing the fired-on colors in a 3% hydrochloric acid solution for 5 hours at a temperature of 20°C. This line of work is being continued. Future results may indicate the desirability of making the conditions of this test less severe. If a color will resist the action of this treatment we may assume that it will resist ordinary chemical action under prolonged service. It was noted that when the quantitative tests were made on these colors the very small amounts of lead extracted failed to affect the gloss of the acid-resistant overglazes.

CERAMIC LABORATORIES
THE ROESSLER AND HASSLACHER CHEMICAL CO.
PERTH AMBOY, N. J.

# A STUDY OF THE CALCIUM-SODIUM RATIO OF CERTAIN WATERS[1]

By R. A. Hart

ABSTRACT

As soluble materials are leached from alkaline soils they may become compact and refractory. This phenomenon is hindered by the presence of calcium or magnesium. Data on calcium-sodium ratios of river waters in different localities are given. It is believed that an unfavorable ratio from the agricultural standpoint would be a favorable ratio with respect to ceramics. The possibilities of use of waters of low calcium-sodium ratio in tempering clays to produce greater density are to be investigated.

## Introduction

In the reclamation of alkaline clay soils by drainage and leaching it has been observed that, under certain conditions, the removal of soluble materials is very difficult owing to the fact that the soil becomes more or less impermeable to water as leaching progresses. Laboratory experiments have corroborated field observations and have demonstrated that the rate of percolation may fall very low.

The soil particles are dispersed and the mass becomes compact and refractory and entirely unsuited for agricultural purposes.

It appears to be the consensus of opinion that the condition is brought about by the presence of sodium and potassium salts in the soil or leaching water, or both, and that the phenomenon is hindered by the presence of calcium or magnesium salts.

As a rule all of these salts are present and it is the conclusion of many investigators that the incidence of the phenomenon depends upon the ratio of the calcium plus the magnesium salts to the sodium plus the potassium salts.

The calcium-sodium ratio is said to be favorable if the phenomenon is inhibited and unfavorable if the phenomenon is exhibited. Just what constitutes a favorable ratio has not been established with any degree of precision.

## Data on Relation of Calcium-Sodium Ratio of Streams to Clay Permeability

Hilgard reports that the average calcium-sodium ratio of nineteen of the world's greatest rivers is 84:16 while that of the River Nile ranges from 69:31 at high stage to 79:21 at low stage. Herman Stabler of the U. S. Geological Survey, in his paper entitled, "Some Stream Waters of the Western United States," reports the following calcium-sodium ratios for nineteen important streams in the western part of this country.

[1] Presented at the Annual Meeting, American Ceramic Society, Atlantic City, N. J., February, 1928. (Heavy Clay Products Division.) Received December 12, 1927

machine, however, was not operated as a "decksweeper" because all but two of the grinding plates were removed. The rotating system of this machine, consisting of a 7-inch shaft, 66 20-pound hammers, and 2 fly wheels, weighed approximately 7500 pounds. It was driven by direct connection through a flexible coupling to a G. E. 100 H.P., 900 speed squirrel cage motor.

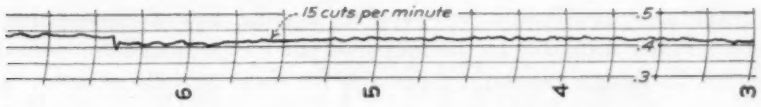



FIG. 2.—L-24 power determinations at Streator (Ill.) Brick Co. Graphic watt meter chart of Chambers royal auger, standard brick die, Chambers No. 10 multiple cutter. G. E. 75 H.P. 600 speed slip ring motor with auger shaft turning at 17 r.p.m.

Kw. input to motor = 1.34 × 125 × chart reading
At 15 cuts per min. = 1.34 × 125 × 4.3 =
15,300 brick per hour = 72 kw. Chart speed = 6 inches per hour

The capacity of the pug mill, auger machine, and cutter, as operated, is approximately 17,000 standard-size building brick per hour. The capacity of the hammer mill, as operated, is somewhat greater than a ton a minute of ground shale through 8-mesh screen when mine run shale, as mined by one yard drag line bucket, is fed to it.

The figures given herewith were secured under ordinary operating conditions and they do not in any case represent special test conditions. It so happened that in no cases were any of the machines operating at their maximum capacity.

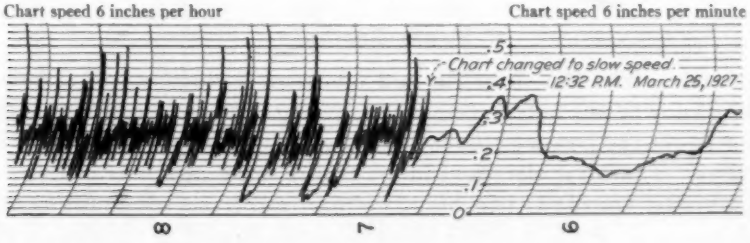



FIG. 3.—L-20 hammer mill grinding tests at Streator (Ill.) Brick Co. Graphic watt meter chart of Williams No. 7 "deck sweeper." Hammer mill directly connected to G. E. 100 H.P. 900 speed squirrel cage motor.

Kw. input to motor = 1.34 × 250 × chart reading

The bucket elevator was 85 feet center to center vertically, composed of two 6-inch pitch pintle chains, carrying 18- by 10-inch malleable iron buckets suspended between the chains spaced 2 feet 6 inches apart; the head shaft sprockets were 2 feet 10½ inches pitch diameter. A knuckle shaft was used at the top of the elevator to make it

a perfect discharge type. The head shaft was driven by being directly connected through a Thomas flexible coupling to a Ganschow planetary type 50:1 ratio spur gear reducer which in turn was directly connected through another Thomas coupling to a G. E. 15 H.P., 1200 speed squirrel cage motor. Chain speed of this machine was 208 feet per minute; its capacity was 75 to 95 tons gross per hour (including tailings). It was found desirable after this test to increase the chain speed of this machine to give it sufficient capacity to take the maximum capacity of the hammer mill, due to the fact that the hammer mill considerably exceeded its design capacity, especially for short periods of time.

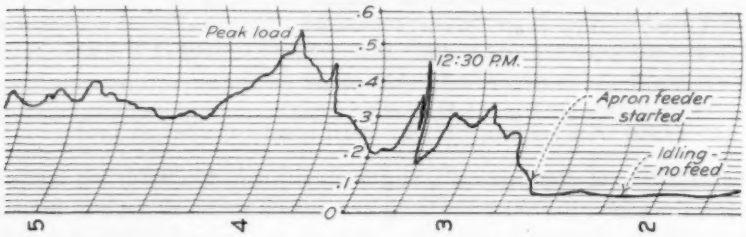



FIG. 4.—L-20 hammer mill grinding tests at Streator (Ill.) Brick Co. Graphic watt meter chart of Williams No. 7 "deck sweeper." Hammer mill directly connected to G. E. 100 H.P. 900 speed squirrel cage motor.

Kw. input to motor = 1.34 × 250 × chart reading
Idling load = 1.34 × 250 × .06 = 20.5 kw.
Peak load = 1.34 × 250 × .5 = 167. kw.
Chart speed = 6 inches per minute

## Power Readings

Assuming that the electrical and mechanical efficiency of the motor itself is known, it is only necessary to measure the electrical input to the motor to get the power actually delivered to the drive and to the driven machine. The total electrical input to the drive motor is in kilowatts and kilowatt hours. It is customary to rate the power requirements of machines of all kinds in brake horse power delivered to the driven shaft of the machine. In the figures given below, wherever horse power is given it is the brake horse power at the motor shaft and differs from the electrical input by exactly the assumed efficiency of the motor. In making the following determinations in each case, an ordinary service type integrating watt-hour meter was connected into the motor leads using suitable current transformers where necessary. At the same time an Esterline Angus recording watt meter was connected into these same motor leads to secure the instantaneous kilowatt input.

## Data

### Esterline Angus Recording Watt Meter

Chart reading × constant = kw.

Kw. × 1000/746 = kw. × 1.34 = electrical input in H.P. or

Chart reading × 125 × 1.34 = electrical input in H.P.

Mechanical H.P. = chart reading × 125 × 1.34 × 80% efficiency = brake H.P. at motor shaft.

See charts for data on each machine.

### Service Type Watt-hour Meter

#### Pug Mill

| Date | No. brick made | Meter reading |
|---|---|---|
| 5–31–27 | 91,250 | 66.1 |
| 6– 1–27 | 143,180 | |
| 6– 2–27 | 162,790 | |
| 6– 3–27 | 129,210 | |
| 6– 4–27 | 110,960 | |
| 6– 6–27 | 113,150 | |
| 6– 7–27 | 94,170 | |
| | | 86.2 |
| | Total 844,710 | |

(86.2 − 66.1) × 80 = 1608.0 kw. hrs.

1608/844.71 = 1.905 kw. hrs. /M brick

### Brick Machine

| Date | No. brick made | Meter reading |
|---|---|---|
| 5– 4–27 | 0 | 33.9 |
| 5– 5–27 | 30,660 | |
| 5– 6–27 | 92,710 | |
| 5– 7–27 | 18,250 | |
| 5– 9–27 | 92,710 | |
| 5–10–27 | 36,500 | |
| 5–11–27 | 84,680 | |
| 5–12–27 | 17,520 | |
| 5–13–27 | 105,850 | |
| 5–16–27 | 107,310 | |
| 5–17–27 | 81,030 | |
| | | 66.1 |
| | Total 667,220 | |

(66.1 − 33.9) × 80 = 2576.0 kw. hrs.

2576/667.22 = 3.86 kw. hrs. /M brick

Current transformer ratio = 80:1

### Bucket Elevator

| Partially loaded | | | Partially loaded | | |
|---|---|---|---|---|---|
| Time for 10 revs. (secs.) | Disk r.p.m. | H.P. | Time for 10 revs. (secs.) | Disk r.p.m. | H.P. |
| 62 | 9.7 | 7.5 | 46 | 13.1 | 10.1* |
| 53 | 11.3 | 8.7 | 65 | 9.2 | 7.1 |
| 60 | 10.0 | 7.7 | 70 | 8.6 | 6.6 |
| 57 | 10.5 | 8.1 | 62 | 9.7 | 7.5 |
| 67 | 9.0 | 6.9 | 50 | 12.0 | 9.2* |
| 66 | 10.7 | 8.2 | | | |
| 56 | 9.1 | 7.0 | Fully loaded | | |
| 63 | 9.5 | 7.3 | Time for 10 revs. | Disk r.p.m. | H.P. |
| 59 | 10.2 | 7.9 | 39 | 15.4 | 11.9 |
| 62 | 9.7 | 7.5 | 36 | 16.6 | 12.9 |
| 45 | 13.3 | 10.3* | 39 | 15.4 | 11.9 |
| 47 | 12.8 | 9.9* | 43 | 14.0 | 10.8 |
| 65 | 9.2 | 7.1 | | | |

*These figures were taken when buckets were about level full, which is standard practice. The rate of feeding was increased temporarily to permit taking these readings.

kw. = 720 × rev./min. of disk.

H.P. = .80 motor efficiency × 720/746 × rev./min. = .772 × r.p.m.

Note: Chain speed as above = 208 ft./min.

### Hammer Mill Motor

| | |
|---|---|
| Final meter reading | 33.9 |
| Original meter reading | 0.0 |

Due to the use of 400 ampere current transformers this mus be multiplied by 80.

33.9 × 80 = 2712.0 kw. hours.

337 (shale carloads) × 7.5 (tons per car) = 2727.5 tons of ground shale.

2712.0/2727.5 = 0.9943 kw. hours/ton of ground shale.

Ogden Engineering Company
Ottawa, Illinois

# BRICK MACHINE, BUCKET ELEVATOR, AND HAMMER MILL POWER DETERMINATIONS[1]

By D. P. Ogden

ABSTRACT

Power measurements on brick machinery are determined and compared.

Approximately a year and a half ago a Chambers pug mill, auger, and cutter, and a Williams hammer mill were installed in the plant of the Streator (Ill.) Brick Co. After these machines had been in operation approximately a year, the accompanying power determinations were made. The pug mill was the No. 26 spur gear pulling type with a tub 14 feet 9 inches long and 28 inches wide by 36 inches deep, with a knife shaft turning over at 21 r.p.m. Drive was by G. E. 30 H.P., 720 speed slip ring motor driving through inclosed Morse silent chain and two inclosed spur gear reductions.

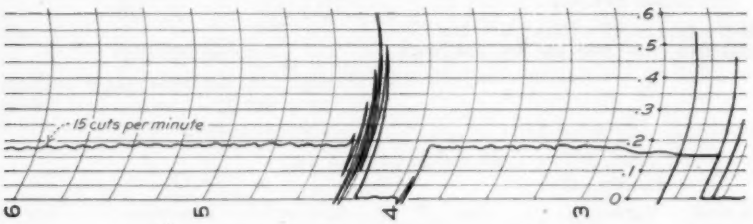



FIG. 1.—L-24 power determinations at Streator (Ill.) Brick Co. Graphic watt meter chart of pulling pug mill G. E. 30 H.P. 720 speed slip ring motor with knife shaft turning at 21 r.p.m.

Kw. input to motor = 1.34 × 125 × chart reading
At 15 cuts per min. of 17 brick per cut = 1.34 × 125 × 1.8 = 15,300 brick per hour = 30 kw. Chart speed = 6 inches per hour

This machine discharged into Chambers Brothers royal auger machine equipped with reciprocating feeder and one spur gear reduction, inclosed and running in oil, built into the machine. Pulley shaft in this machine was driven through an inclosed Morse silent chain through a G. E. 75 H.P., 600 r.p.m. slip ring motor such that the auger shaft turned at a speed of 17.5 r.p.m. The counter shaft which operated the cutter was driven from this same machine through a short leather belt to compensate for the shock put on this drive when the cutter clutch dropped in. The cutter was a Chambers No. 10 multiple brick cutter making 17 standard-size building brick per cut. The hammer mill had a hammer circle tip diameter of 40 inches and an inside width of 48 inches and is described as a No. 7 decksweeper pulverizer. This

[1] Presented at the Annual Meeting, American Ceramic Society, Atlantic City, N. J., February, 1928. (Heavy Clay Products Division.) Received December 23, 1927.

| Stream | Location | Ratio |
|---|---|---|
| Belle Fourche | Belle Fourche, S. D. | 75:25 |
| Big Horn | Fort Custer, Mont. | 66:34 |
| Boise | Boise, Idaho | 58:42 |
| Carson | Hazen, Nev. | 57:43 |
| Colorado | Palisade, Colo. | 55:45 |
| Colorado | Yuma, Ariz. | 51:49 |
| Gila | San Carlos, Ariz. | 41:59 |
| Green | Jensen, Utah | 63:37 |
| Link | Klamath Falls, Ore. | 46:54 |
| Little Colorado | Woodruff, Ariz. | 44:56 |
| Milk | Havre, Mont. | 39:61 |
| North Platte | Fort Laramie, Wyo. | 68:32 |
| Pecos | Dayton, N. M. | 57:43 |
| Rio Grande | El Paso, Tex. | 52:48 |
| Sacramento | Red Bluff, Calif. | 59:41 |
| Salt | Roosevelt, Ariz. | 41:59 |
| Shoshone | Cody, Wyo. | 51:49 |
| Truckee | Derby, Nev. | 48:52 |
| Yellowstone | Billings, Mont. | 58:42 |

It is reported by Carl S. Scofield and Frank B. Headley of the U. S. Bureau of Plant Industry, in their paper on "Quality of Irrigation Water in Relation to Land Reclamation" that the land irrigated by the Belle Fourche and North Platte Rivers is notably free from difficulties as to permeability while the land irrigated from the Salt, Gila, Truckee, and Carson Rivers is notably subject to difficulties of impermeability. The writer has observed difficulties in the Boise area and at Yuma. This would suggest that to be favorable the ratio should be at least 60:40 or possibly 65:35.

The reference to the calcium-sodium ratio at high and low stages of the River Nile calls attention to a variation that has been noted elsewhere. For example R. H. Forbes presents the following results of analyses of water from the Salt River in Arizona:

| Period | Ratio |
|---|---|
| Summer flood water (Sept. 2–9, 1899) | 39:61 |
| High and low summer water (Sept. 10–Oct. 10, 1899) | 26:74 |
| Low winter water (1899–1900) | 21:79 |
| Very low summer water (June 1–Aug. 4, 1900) | 23:77 |

The writer recently had occasion to study the calcium-sodium ratio of the water of the Bow River in southeastern Alberta. Samples taken April 2, 1927 showed a ratio of 90:10 and 76:24, the former being higher than the average reported by Hilgard for nineteen great rivers of the earth and the latter being comparable with that of the River Nile at low stage. The former is almost unbelievably high for a stream in the arid region but was corroborated by an analysis of a sample drawn from the irrigation system in June, 1921.

The ratio is extremely variable, however, samples taken in June 1927 showing an average ratio of only 44:56 while samples taken in August 1927 showed an average ratio of only 23:77.

It seems entirely reasonable to expect that the calcium-sodium ratio would vary also with the progress of the stream down its course. This is suggested by the ratios of the Green River[2] at Jensen, Utah (63:37), the Colorado River at Palisade, Colorado (55:45) and the Colorado River at Yuma, Arizona (51:49). A better example is that of the Sevier River in Utah, data of which follow:

| Station | Total salts | Calcium-sodium ratio |
|---|---|---|
| Clear Creek | 205.8 p.p.m. | 93: 7 |
| Sigurd Bridge | 831.3 p.p.m. | 24:76 |
| Near Delta | 1316.4 p.p.m. | 36:64 |

The distance from Clear Creek to Delta is well over one hundred miles. Sigurd Bridge is some 70 miles from Delta. The normal flow of the river is entirely diverted several times in its course, return water being an important source of supply. There is a large storage reservoir a few miles above Delta.

It is the impression of the writer that streams in the humid section of the country would show consistently higher calcium-sodium ratios than those of the arid section. This impression is borne out by the comparison of data in the table prepared by Stabler. It is the belief of the writer than an unfavorable ratio, from the agricultural standpoint would be a favorable ratio with respect to ceramics, and vice versa.

## Conclusions

If these assumptions be true then clays deposited by water in the arid section should have a greater density than chemically comparable clays deposited by the waters of the humid section and should be superior for certain purposes, as for example, the manufacture of paving brick.

Also it would seem reasonable to expect that tempering clays with water having a relatively low calcium-sodium ratio should produce a body of greater density. The writer proposes to follow up this matter experimentally.

Many clays show approximately the same chemical analysis as shales, which means that the superiority of the shales for certain purposes is purely a matter of greater density. The desirability of ascertaining the calcium-sodium ratio of water used in tempering clay is suggested, since an unfavorable ratio could be corrected very easily by the introduction of a small amount of a suitable sodium compound.

Western Clay Products Association
Salt Lake City, Utah

[2] A principal tributary of the Colorado.

# PLASTICITY OF CLAY[1]

By Leon E. Jenks

ABSTRACT

The cause of plasticity of clay is the formation in the moistened clay of a continuous external phase through the action of water in making gelatinous the material that forms the enveloping surface around the non-gelatinous particles and aggregates present in the clay. Peptizing and flocculating effects of electrolytes and organic matter are discussed. A possible method for evaluating the relative plasticity of clays and the results obtained on some commercial clays using this method, are given.

## Introduction

While a working knowledge of plasticity of clay goes back to the dawn of civilization in widely scattered primitive peoples, its definition in terms that would allow its measurement and explains its cause has never been entirely satisfactory to any one. Part of this may be due to a difference in meaning attached to the term plasticity in different arts and sciences; but also, seemingly, that within the ceramic field the one term has to cover many things. To a brick maker, a plastic clay is one that works well in his machine and is capable of being kneaded into a "good" paste; to a potter, the bonding power is the important factor; to a slip-caster, plasticity is a synonym of viscosity. The term "clay" in this paper is used to describe the material known to the geologist and the ceramist as clay; "a plastic substance[2] is one that can be molded by pressure," "permanent deformation involves no rupture and a break is self-healing."[3]

The term, plasticity of clay, is used in the special sense of the clay-worker to express that property of a clay which enables the moistened mass to be molded without rupture into a shape which will be retained when the mass is dried and fired. This definition of plasticity of clay connotes that a clay slip has plasticity only when there is no free water present to separate the clay particles. When the material suspended in the water is the inside or dispersed phase and the water itself, that is free to move away from the particle, is the outside or dispersing phase then the clay slip has the property of viscosity. When there is no free liquid present to form the outside phase, then the inside phase is formed of the unchanged particles and aggregrates and the outer phase is formed by a continuous film, gelatinous in its nature, formed from the hydrated material and the adsorbed water. Such a system has coherence and bonding power. It has the property of plasticity of clay.

---

[1] Presented at the Annual Meeting, American Ceramic Society, Atlantic City, N. J., February, 1928. (White Wares Division.)

[2] Duff: A Text Book of Physics, p. 119 (1916).

[3] Bancroft: Applied Colloid Chemistry, p. 183 (1926).

**A Possible Method for the Evaluation of the Relative Plasticity of Clay**

Finding in the literature no method for the measurement of the plasticity of clay that seemed suited for the purpose, influenced by the statement of Rohland[4] that the amount of water to secure the highest possible plasticity is a measure of plasticity because as soon as sufficient water is present to dissolve the coagulable colloids, a saturation point is reached and no more water can be adsorbed without the clay losing its stiffness, it was concluded that when sufficient water was added to a clay to give the greatest possible depth of adsorbed film, with the opposite surfaces of this film adsorbed on adjacent clay particles, then any added liquid would break up this one film into films having one adsorbed surface in contact with the particle and one free surface in contact with free water molecules. With this added layer of free water the ability of the film to bond the particles of the clay would be destroyed and with it the plasticity of the material. What would then remain would be a suspension of clay in a liquid. This theoretical study lead to the test mentioned by Bancroft[5] and later called the Bancroft Test by Talwakar and Parmelee.[6] This plasticity test depends little on personal judgment. It is simple and requires no elaborate apparatus. The material is not destroyed and the test may be repeated on the same sample if it is desired. The relative results are consistent with the knowledge of the potter that the plasticity of clay is greatly affected by the water content of the mass and that the plasticity of clay passes through a maximum value when increasingly larger amounts of water are added to a dry clay.

TABLE I

THE RELATIVE PLASTICITY OF SOME COMMERCIAL CLAYS

| Clay | Plasticity | Clay | Plasticity |
|---|---|---|---|
| Albany slip (New York) | 4 | Highland pot | 10 |
| Allen (Maryland bond) | 30 | Kaolin (Florida, washed) | 5 |
| Bramlett (Mississippi bond) | 60 | Kentucky No. 5 bond | 15 |
| Brimfield (Connecticut Valley) | 8 | Kentucky No. 6 bond | 12 |
| England ball | 10 | Lignite | 7 |
| Feldspar | 2 | Norton bond B | 8 |
| Fullers' earth | 6 | Sandy open | 1/2 |
| Hickory | 12 | Shale (Corning, ground) | 6 |
| | | Shippach (Germany) | 25 |

In Table I is given the relative plasticity of some commercial clays as evaluated by this method of testing, which is as follows: Five grams of dry ground clay are weighed out, moistened with water to its best plasticity as determined under the thumb, well kneaded and molded into a ball between the palms of the hand, and allowed to dry for a day.

[4] *Zeit. für anorg. Chem.*, **41**, 325 (1904).

[5] Bancroft and Jenks, *J. Phys. Chem.*, **29**, 1215 (1925).

[6] *Jour. Amer. Ceram. Soc.*, **10**, 673 (1927).

The air-dried ball is then so placed in an excess of water at room temperature that, as the ball of clay disintegrates, the sedimented particles fall away from it. The time in minutes taken for the disintegration of the ball into a mud gives a measure of the relative plasticity of the clay.

The real difficulty in carrying out this plasticity test comes in the choosing of the correct amount of water to insure that the material that forms the test-ball has its highest plasticity. This is just short of stickiness from excessive water and both too much and too little water will give low results. This effect of more than the optimum amount of water is shown in Table II.

TABLE II

EFFECT OF MOLDING A CLAY WITH TOO MUCH WATER

| Clay | True Plasticity | Plasticity Found |
|---|---|---|
| Kentucky No. 5 bond | 15 | 9 |
| Fullers' earth | 6 | 4 |
| Feldspar | 2 | 1/2 |
| Bramlett | 60 | 55 |

The stickiness caused by a slight excess of water over that required to develop the best plasticity of the material marks the point where the continuous film with its opposite surfaces adsorbed on adjacent particles is beginning to give away to a state where each clay particle or aggregate is enveloped within a film the outside surface of which is not in contact with a particle of clay. This point, and not the point of zero fluidity[7] marks the dividing line between viscosity and plasticity of clay. Seemingly Bingham has been misunderstood as what he actually says is that zero fluidity "apparently sharply demarcates viscous from plastic flow."[7] Plastic flow and plasticity of clay are not synonymous terms.

## The Cause of Plasticity of Clay

The laminated structure theory and the colloidal matter theory of the cause of plasticity of clay have long separated the physical chemist and ceramist. Creeping in between these has been one based on the presence of saline matter. Purdy and Moore[8] gave as an "extremely probable assumption that it is the influence of adsorbed salts that give clay its plasticity." Bancroft[3] said

> If we have a gelatinous film which is adsorbed strongly by the solid particles and which can take up and lose water, we shall have plasticity. In the case of clay the gelatinous material may be hydrous alumina, hydrous silica, or some intermediate composition. The difficulty, however, is to account for its remaining plastic after moderate

[7] Bingham: Fluidity and Plasticity p. 54 (1922)

[8] *Trans. Amer. Ceram. Soc.*, 9, 222 (1907).

[3] Bancroft Applied Colloid Chemistry (1921) p. 160.

drying and for its readsorbing water to form a gelatinous mass. This is probably due to the presence of some salt, but we do not know what salt and consequently we cannot tell why one clay is plastic and another not, and we do not know what to add to a non-plastic clay to make it plastic.

There is much evidence of the presence of gelatinous material in clay,[9] and much knowledge has accumulated on the gelatinous properties of adsorbed films.[10]

TABLE III

ACTION OF LITHIUM CHLORIDE ON CLAY

| Ratio Salt to Clay | Kind of Clay | Plasticity Original | Plasticity Final |
|---|---|---|---|
| 1:2000 | Kaolin, Fla., washed | 5 | 7 |
| 1:1000 | " " " | 5 | 10 |
| 1: 400 | " " " | 5 | 16 |
| 1: 500 | No. 5 Kentucky bond | 15 | 100 |
| 1: 400 | Brimfield | 8 | 40 |

It has been found that the plasticity of a clay could be changed through the addition of lithium salts alone or with other salts, and that gelatinous alumina, but not gelatinous silica, to which a lithium salt had been added could be repeatedly alternately dried and remoistened to plasticity of clay.[5] For the moment, it seemed that plasticity of clay was the specific property of gelatinous alumina through the action of adsorbed lithium.

TABLE IV

PLASTICITY TEST VALUES FOR FLORIDA KAOLIN

| Material added | $Na_2O$ equivalent % | Plasticity |
|---|---|---|
| | | 5 |
| Sodium chloride | 0.14 | 7 |
| Sodium carbonate | 0.12 | 15 |
| Sodium chloride and carbonate | 0.067 | 12 |
| Sodium hydroxide | 0.6 | 8 |
| Lithium chloride | 0.15 | 10 |
| Lithium carbonate | 0.33 | 11 |
| Lithium phosphate | 0.09 | 11 |
| Lithium sulphate | 0.34 | 6 |

Although Professor Lord of Ohio State University had found varying amounts of lithium compounds present in all the Ohio clays he examined,[11] no lithium could be detected in the clays used in this investigation.[12] The problem of why lithium salts changed the plasticity of clay was then examined. It was found that those lithium salts that made a clay more plastic when the clay and the lithium salt was in

[9] Quincke, *Ann. Physik.*, **7** [4], 74 (1902); Cushman, *Jour. Amer. Chem. Soc.*, **25**, 451 (1903).

[10] Dumont, *Comp. Rend.*, **149**, 1087 (1909); Hall: The Soil, pp. 34–39 (London, 1912); Bole: *Jour. Amer. Ceram. Soc.*, **5**, 469 (1922); Wilson and Ries: Colloid Symposium Monograph, p. 14 (1923).

[11] *Trans. Amer. Inst. Min. Eng.*, **12**, 505 (1883–84).

[12] Private communication from Jacob Papish, Asst. Professor of Chemical Spectroscopy, Cornell Univ.

the form of a dilute slip and the water was evaporated off on a hot-water bath, always gave an alkaline reaction to the residue. The addition of lithium sulphate did not make the clay definitely alkaline nor did lithium sulphate give much change to the plasticity of clay. A lithium salt is no more effective in changing the plasticity of a natural clay or of making gelatinous alumina plastic than, for example, a combination of sodium hydroxide and sodium chloride (Table IV).

Not only did the combined action of sodium hydroxide and sodium chloride duplicate the effect of lithium chloride on gelatinous alumina or on a clay but also, as with the lithium salt, the addition of combined hydroxide and chloride to gelatinous silica did not give a plasticity that would long survive when the gelatinous material was alternately dried and remoistened. It was the long study of this difference of behavior between gelatinous alumina and gelatinous silica that gave the theoretical explanation of the cause of plasticity of clay. Both silica and alumina are peptized by sodium hydroxide. Sodium chloride flocculates peptized alumina but it did not flocculate peptized silica. When in place of sodium chloride a material was substituted that flocculates peptized silica, a plastic silica was as readily obtained as a plastic alumina. Also through the use of both flocculating and peptizing agents other gelatinous materials than those containing alumina or silica were given the property of plasticity of clay. Any material with the texture of a clay that may be simultaneously peptized and flocculated will have plasticity of clay when it is properly moistened.

The following criteria were used to establish the presence of plasticity of clay. A material was classed as not having the property of plasticity if it failed in any criterion.

(1) The finely ground material when moistened to plasticity of clay must have the characteristic "feel" of a clay.

(2) The air-drying of the moistened material must not give a cemented aggregate.

(3) Repeated alternate moistening to plasticity of clay and moderate drying must not remove the properties of bonding and of mobility and of deformation without rupture when the material is again remoistened to plasticity of clay.

(4) When the material is made up into a dilute slip and the supernatant liquid decanted from the well-settled sludge, the redrying and the remoistening to plasticity of clay must not give a nonplastic mass.

(5) The material, which has been molded into a test-ball when it is moistened to its highest plasticity of clay and then air-dried, must not spall away at once, like a finely ground sand when placed under water, but it should form a mass that is plastic or which may be readily kneaded back to a plastic material.

## Summary and Conclusions

The cause of plasticity of clay is the formation in the moistened clay of a continuous external phase through the action of water in making gelatinous the material that forms the enveloping surface around the nongelatinous particles and aggregates present in the clay.

The material that is capable of becoming gelatinous upon moistening is maintained in this condition by a simultaneous peptizing and flocculation, which preserves the gelatinous envelope and hinders or prevents the change of its material into something that will not take up water to again become gelatinous when moistened to plasticity of clay.

The presence of organic matter, of dissolved carbon dioxide, or of electrolytes in the water or in the clay itself is not the cause of plasticity of clay. Such materials are agents through the action of which a sufficient amount of material, capable of becoming gelatinous when moistened, is formed and, once having been formed by any agent, is maintained.

As gelatinous alumina and gelatinous silica were each made into a plastic material when it was moistened, the constituent materials of a natural clay and their structure are important only as far as kind of material and fissility may aid in the formation of a material that is capable of becoming gelatinous when moistened. While fissile minerals are not necessary, the presence of such should aid in the readiness with which the material could be reduced to a size that it could become gelatinous when moistened.

A possible method for the evaluation of the relative plasticity of clay is given and also the relative plasticity of some commercial clays as obtained with this method.

# USE OF THE SIMULATIVE TEST FURNACE AS A MEANS OF MAKING COMPARATIVE TESTS OF FIRE BRICK[1]

By G. L. Rogers

ABSTRACT

The Navy Simulative Service Test for refractories is described, specifications for the test and the furnace used being given. The simulative service furnace has found application in making comparative tests of different brands of refractories, development of and improvement of standard fire brick, and as a control test for maintaining quality of the product.

## Introduction

H. H. Norton and R. L. Porter[2] have described a furnace used in making the so-called "Simulative Service Tests" which all refractories must pass in order to be placed on the acceptable list of the U. S. Navy for use in marine oil-fired boilers.

The Simulative Service Test is the best test yet devised for obtaining a direct comparison between different brands of brick where excessive load or slag is not a factor. The probabilities are that any brick which survives the test will stand up under load as well.

The original 1916 Navy specifications required that fire brick and fire clay have an analysis of approximately 54% silica and 41% alumina, with a maximum of 5% fluxes and a minimum fusion point of 3100°F. It was found, however, that bricks meeting these specifications would occasionally fail in service, and consequently, the specifications did not eliminate all bricks which were unsatisfactory for use in in naval oil-fired boiler furnaces. The Simulative Service Furnace was designed with the idea of proving definitely the suitability of fire brick for marine purposes before putting them in the furnace walls.

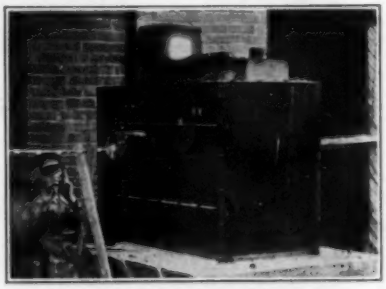


Fig. 1.—End view of furnace.

The authors state that the Simulative Test demonstrates conclusively the capacity of the refractories under examination to withstand satisfactorily the conditions to which they are subjected in the furnaces of naval oil-fired boilers. Brands which have given satisfactory service in oil-fired boilers on shipboard, pass the test in good condition, while fire brick which pass the Simulative Test perform satisfactorily in service. At the time this article was written, no fire brick with an analysis of over 61% silica had survived

[1] Received March 10, 1928.

[2] H. H. Norton and R. L. Porter, "The Method of Selecting Refractories for Marine Purposes of the Navy," *Jour. Amer. Ceram. Soc.*, **7** [7], 575–82 (1924).

the Simulative Service Test, and tests made at Renton bear out this statement.

FIG. 2.—Panel A: 74.12 $SiO_2$, 23.00 $Al_2O_3$, 3.85 total fluxes.

FIG. 3.—Panel B: 75.08 $SiO_2$, 21.00 $Al_2O_3$, 3.76 total fluxes.

## Description of the Simulative Service Test

The test, as described in U. S. Government Master Specification No. 268A, is as follows:

Tests are conducted in small oil-fired furnaces. For comparative purposes, one side wall of the combustion chamber is built up of brick and cement of approved brands, and the other side wall of brick and cement of the samples under examination. Both walls are backed uniformly with three inches of insulation. An air-atomizing fuel burner is used. The flame sweeps the length of the furnace, curves upward, and returns to the front, then up the stack, from which it escapes horizontally toward the rear of the furnace.

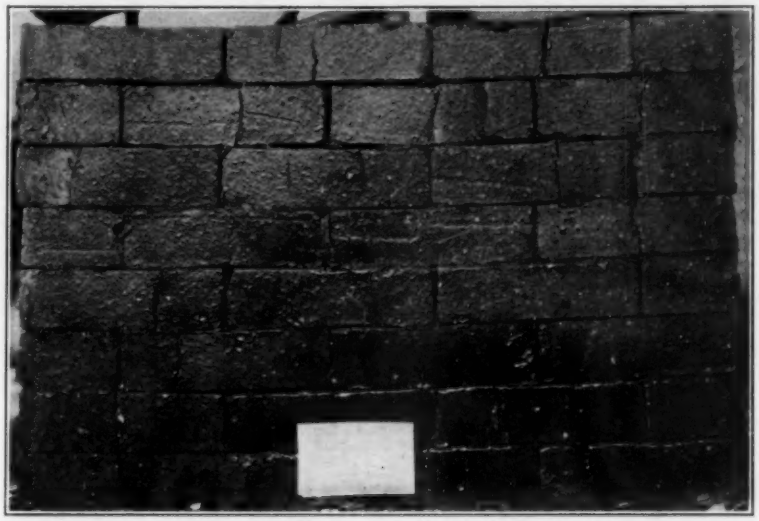


FIG. 4.—Panel C: 70.06 $SiO_2$, 26.67 $Al_2O_3$, 3.05 total fluxes.

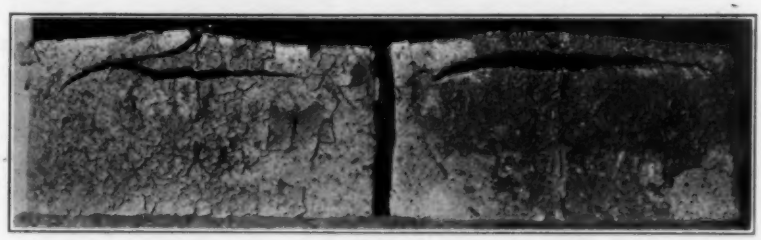


FIG. 5.—Brick for Panel C.

The test consists of two runs, each of 24 hours duration, at furnace temperatures of 1590 and 1650°C (approximately 2895 and 3000°F, respectively).

Refractory furnace face temperatures are recorded at 30-second intervals by means of a recording radiation pyrometer, sighted into a closed end refractory tube placed in the rear wall of the furnace. The radiation pyrometer is checked at quarter-hour intervals with an optical pyrometer, sighted on the refractory walls through the front of the furnace, above the burner.

Temperatures of the outer face of the brickwork of each side wall are determined at half-hourly intervals with an optical pyrometer,

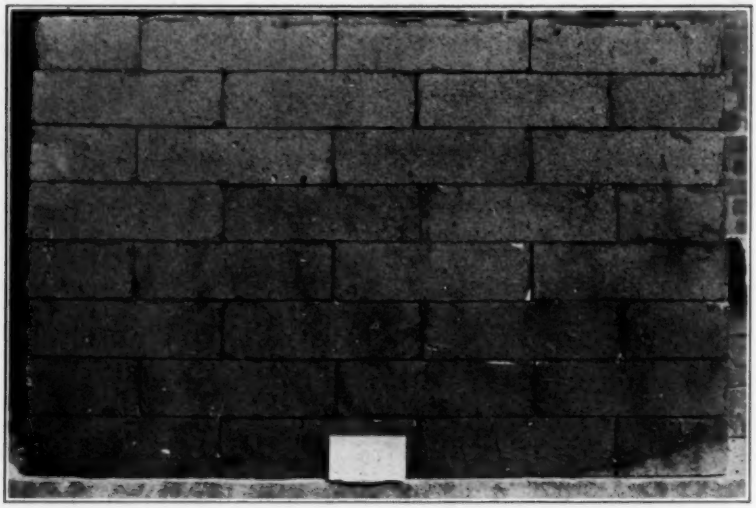


FIG. 6.—Panel D: 55.94 $SiO_2$, 41.07 $Al_2O_3$, 2.71 total fluxes.

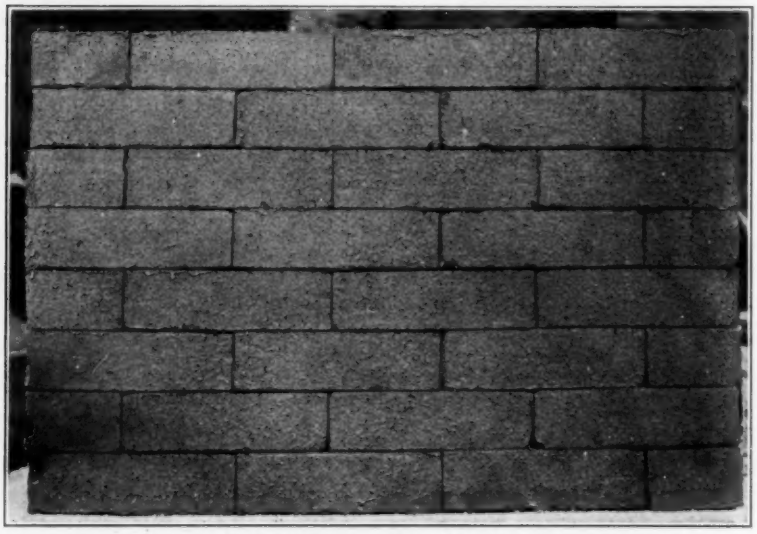


FIG. 7.—Panel E: 50.40 $SiO_2$, 40.42 $Al_2O_3$, 6.38 total fluxes.

sighting on the brickwork through suitable tubes, the ends of which are placed flush with the wall. The tubes are carefully lagged and plugged to prevent radiation losses.

A spalling test is conducted at the conslusion of each run by injecting air at room temperature, under forced draft, into the furnace im-

FIG. 8.—Panel F: 63.14 $SiO_2$, 32.70 $Al_2O_3$, 4.14 total fluxes.

mediately after shutting off the oil supply to the burner; the injection is continued for two hours.

The comparative heat insulating properties, together with the relative conditions of the side walls, determine whether or not the material under test is acceptable for use in service.

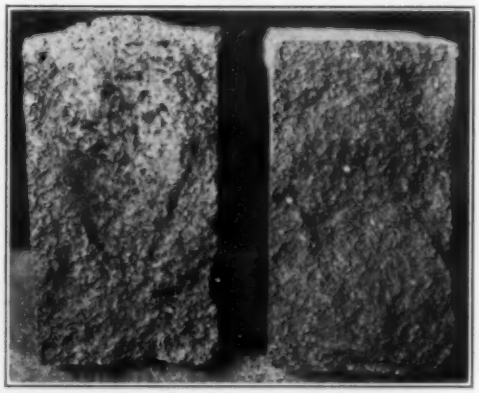


FIG. 9.—Brick from Panel F.

The combined results of workmanship, chemical analyses, softening point and absorption and load tests, where required, shall be considered a suitability test, but (at the discretion of the purchaser) the Simulative Service Test may replace all other tests included in the suitability test.

Workmanship and softening point determination shall be considered as a control test.

## Description of the Furnace

The furnace consists of a sheet metal casing $42^1/_2$ inches long, 30 inches high, and $19^1/_2$ inches wide. The walls or panels of brick to be

tested are built as shown in the figures. The walls are $3^1/_2$ courses long and 8 courses high. The thickness of the walls is the width of one brick,

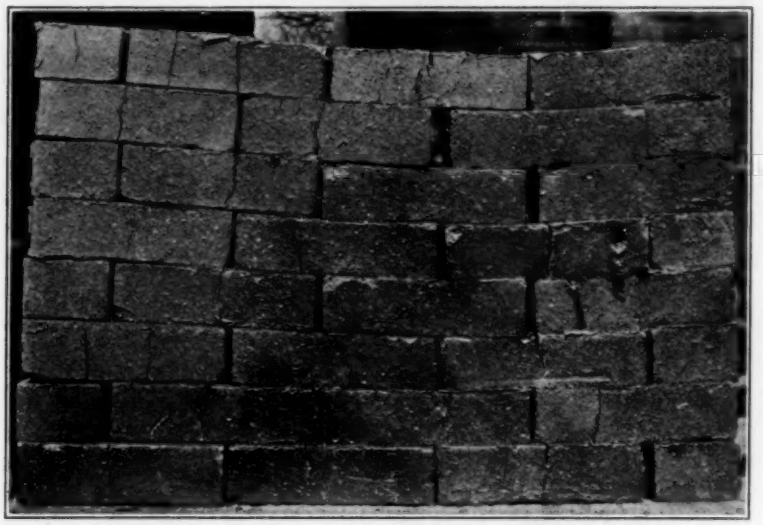


FIG. 10.—Panel H: 64.00 $SiO_2$, 32.10 $Al_2O_3$, 3.60 total fluxes.

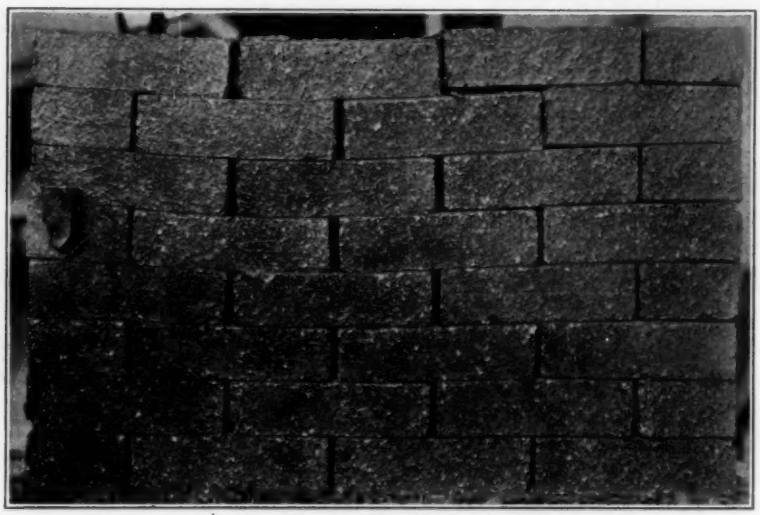


FIG. 11.—Panel I: 73.02 $SiO_2$, 23.48 $Al_2O_3$, 3.24 total fluxes.

*viz.*, $4^1/_2$ inches. The distance between the competing panels is only $4^1/_2$ inches, which insures both walls being subjected to the same treatment. The fuel oil used is of approximately 18 gravity.

## Tests Made

The writer's first experience with the simulative service test furnace was while assisting in the development of a fire brick suitable for use in the Navy. Recent use of the simulative furnace has been made at Renton, along with other tests, in the developing of and improving of standard fire brick and as a control test in maintaining its quality at, or above, a given point.

It is to the credit of applied technical methods that a comparatively high-grade fire brick, of proved quality in service, is now being made from the same materials from which heretofore only a brick of mediocre quality was being produced.

Comparative tests of the product with practically all brands of fire brick coming into this market have been made by means of the simulative test furnace. By the results of these tests, we know exactly how the brick stand in comparison with other competing brick.

The photographs show the results of some of the tests made on different brands. It is interesting to note the silica content of the brick used in the different tests. Only those brick with less than 60% silica have come through the test without showing excessive shrinkage or softening.

Failure of brick in this test does not condemn that brick as being of no value, for all of the brands tested are doing good service in many positions. Failure in this test does eliminate that brick for high heat, heavy duty service, such as is encountered in marine naval oil-fired boilers.

GLADDING MCBEAN AND COMPANY
SEATTLE, WASHINGTON

# NOTES ON POTASSIUM BISULPHATE FUSIONS

By W. Raymond Kerr[1]

The increasing use of high alumina material in the manufacture of refractories necessitates extra care on the part of the analyst in making certain that all the material in a sample is thoroughly decomposed before an analysis is started. Potassium bisulphate is of great value in decomposing aluminous refractories, but, as sometimes used, causes trouble due to spattering as the fusion is in progress. The following procedure eliminates practically all trouble due to the frothing which takes place when ordinary potassium bisulphate is heated.

Over a suitable burner, heat about fifteen grams of fused lump potassium bisulphate in a well-glazed porcelain crucible, or one of fused silica, until all bubbling has ceased and the melt is in a quiescent state. Then remove the crucible and its contents from the burner and place it on a sheet of asbestos for slow cooling. When cool, the button of fused bisulphate may be removed by inverting the crucible and tapping against the palm of the hand.

These fused buttons are used in making the fusions. It is only necessary to add one of them to the material to be taken into solution and heat in a crucible to a dull red heat till all the material is dissolved. The buttons may be kept for several days without taking up moisture, so that it is possible to make up a stock of them in advance.

When raw material is to be analyzed, it is always advisable to calcine the sample before making a bisulphate fusion. This treatment eliminates the water of hydration which would cause frothing if it were driven off during a fusion. Fusions conducted in the manner outlined usually proceed very quietly. Any material which has a tendency to float on the surface of the melt is dusted over with a little ground fused bisulphate and this treatment usually causes the floating substance to sink.

Three types of crucible are available for the fusion: platinum, porcelain, and fused silica. A fused silica crucible is the best type to use by reason of its insolubility in the melt. Platinum being susceptible to solution, makes it desirable to use some cheaper material. Porcelain which is well glazed inside has been found very satisfactory for certain kinds of control work. Many fusions may be made in a porcelain crucible and the impurity introduced into the sample is negligible in any but the most accurate type of analysis.

Mellon Institute of Industrial Research
Pittsburgh, Pa.

---

[1] Junior Fellow, Refractories Fellowship, Mellon Institute of Industrial Research. University of Pittsburgh, Pittsburgh, Pa. Received March 6, 1928.

# CERAMIC ABSTRACTS

Compiled by the

## AMERICAN CERAMIC SOCIETY

Ross C. Purdy, Editor

Emily C. VanSchoick, Asst. Editor

Abstractors: A. A. Ayars, R. Barta, G. A. Bole, W. M. Clark, P. F. Collins, F. P. Hall, R. A. Heindl, E. B. Hewitt, H. Insley, S. Kondo, J. T. Littleton, Jr., M. E. Manson, D. J. McSwiney, A. J. Monack, Ralph J. Paddock, D. E. Sharp, R. F. Sherwood, H. H. Stephenson, E. J. Vachuska, W. H. Wadleigh, M. G. Westfeldt, A. E. R. Westman, G. W. Wray

**Vol. 7** **May, 1928** **No. 5**


## Author Index to Ceramic Abstracts for May[1]


| AUTHOR | PAGE |
|---|---|
| Ashley, G. H. | 319 |
| Alexander, C. | 272 |
| Alt, L. R. | 291 |
| Armstrong | 315 |
| Azbe, V. J. | 277 |
| Baker, T. S. | 331 |
| Balano | 274 |
| Bayer, J. | 275 |
| Benedicks, C. | 283 |
| Berge, A. | 333 |
| Binns, C. F. | 271 |
| Blackall, A. D. | 315 |
| Blossfeldt, W. | 271 |
| Bodin, V. | 328 |
| de Boer, J. H. | 301 |
| Bole, G. A. | 312 |
| Booze, M. C. | 295 |
| Botwinkin, O. K. | 323 |
| Bouyoucos, G. J. | 320 |
| Bowmaker, E. J. and Cauwood, J. D. | 284 |
| Bradley, W. H. | 319 |
| Brancart, Y. | 291 |
| Braniski, A. I. | 320 |
| Bresser, A. | 310 |
| Brintzinger, H. and I. | 278 |
| British Thomson Houston Co., Ltd. | 280, 304 |
| Brokenshire, E. L. | 320 |
| Brooks, H. L. | 281 |
| Brown, C. | 289 |
| Brown, C. A. and Nielsen, A. C. | 288 |
| Brownlee, W. K. | 303 |
| Buckley, F. | 283 |
| Budnikoff, P. P. and Endowitsky, I. | 306 |
| Burchartz, H. | 329 |
| Burgess, I. J. | 274 |
| Burgess, M. L. | 277 |
| Callen, A. C. and Smith, C. M. | 328 |
| Carter, H. D. | 281 |
| Chance, G. R. L. | 292 |
| Chapman, W. B. | 317 |
| Chatley, H. | 323 |
| Chavance, R. | 271 |
| Clarke, F. S. | 273 |
| Clarke, G. S. | 320 |
| Cob, J. W. | 332 |
| Coblenzer, C. | 329 |
| Comber, A. W. | 297 |
| Compton, W. H. | 327 |
| Cowper, A. D. and Williams, J. F. | 279 |
| Cramer, A. N. | 289 |
| Cummings | 303 |
| Curtis, E. deF. | 271 |
| Czerny, R. | 316 |
| Dale, A. J. | 299, 302 |
| Dennis, M. B. | 274 |
| Deutsche Gold und Silber, etc. | 304 |
| Drake, A. M. | 270 |
| Dunkin, D. D. | 318 |
| Ebright, H. E. | 282 |
| Edwards, M. H. | 301 |
| Eissenlöffel, F. | 291 |
| English, S. and Turner, W. E. S. | 284 |
| Ermes, M. | 284 |
| Euler, B. | 293 |
| Evans, B. S. | 320 |
| Evans, G. S. | 297 |
| Farrington, F. | 330 |
| Fernald, R. H. | 316 |
| Finn, A. N. | 287 |
| Fischer, W. | 321 |
| Fisher, H. D. | 331 |
| Fox, J. H. | 289 |
| Frigon, A. | 330 |
| General Electric Co., Ltd. | 290 |
| Gessner, J. J. | 288 |
| Graafen | 316 |
| Gracia, J. A. | 319 |
| Graf, O. | 278 |
| Granger, A. | 322 |
| Grasselli Chemical Co. | 312 |
| Greaves-Walker, A. F. | 291 |
| Green, A. T. | 297, 298 |
| Green, A. T. and Edwards, H. | 298 |
| Green, E. I. | 307 |
| Green, G. A. and Turner, W. E. S. | 284 |
| Greiner, W. | 282 |
| Grigorjew, P. N. | 323 |
| Grün, R., Becker, W., and Buchholtz, H. | 280 |
| Guernsey, F. H. | 281 |
| Haegermann | 278 |
| Halbherr, F. | 275 |
| Hamilton, B. | 319 |
| Hansen, J. E. | 281, 282 |
| Hansen, W. C. and Brownmiller, L. T. | 320 |
| Haslam and Ward | 302 |
| Hawley, K. A. | 307 |
| Hecht, H. | 329 |
| Heine, M. | 316 |
| Herboth, A. | 275 |
| Herman, H. | 285 |
| Herschel, W. H. | 309 |
| Herske, A. | 330 |
| Heuze, C. | 291 |
| Hill, E. C. | 305 |
| Hind, S. R. and Troop, R. S. | 300 |
| Hodgson, J. L. | 331 |
| Holcroft, C. T. and Doll, C. E. | 317 |
| Howe | 322 |


[1]The abbreviation (*C.A.*) at the end of an abstract indicates that it was obtained from *Chemical Abstracts* by coöperative agreement.

| AUTHOR | PAGE |
|---|---|
| Hubbard, C. L. | 329 |
| Hudleston, L. J. | 323 |
| Hyde-Jocelyn, C. | 274 |
| Hyslop, J. F | 283 |
| mray, O. Y. | 290 |
| Irwin, C. J. | 269 |
| Jacob, K. | 307 |
| Jacobs, F. B. | 269 |
| Jennings, I. E. | 286 |
| Jones, L. S., Henrikson, C. G., and Fisher, G. W. | 307 |
| Jones, W. B. | 331 |
| K. H. | 271 |
| Kallauner, O. | 279 |
| Kay, G. M. | 319 |
| Kempf, W. C. | 294 |
| Kerth, E. C. | 293 |
| Kessler, D. W. and Sligh, W. H. | 326 |
| Kettering, C. F. | 328 |
| Kingsbury, E. F. | 310 |
| Kingsley, C. B. | 290 |
| Klehe, T. | 278 |
| Knittle, R. M. | 333 |
| Knuth, H. | 297 |
| Koehler, W. | 324 |
| Kothny, E. | 295 |
| Kozu, S. and Masuda, M. | 322 |
| Kramers, J. H. | 275 |
| Kraus, E. H. | 319 |
| Kreidl, I. | 283 |
| Kruyt, H. R. | 323 |
| Kühl, H. | 278, 279 |
| Kutchka, K. G. and Swartzlander, T. H. | 289 |
| Ladd, G. T | 329 |
| Lade, K. | 279 |
| Lamal, L. | 295 |
| Lambert, F. B. and Lammert, F. E. | 317 |
| Langtry | 303 |
| Leber, E. | 297 |
| Lee, A. | 273 |
| Lenhart, W. B | 277 |
| Libman, E. B. | 321 |
| Lindsey, G. S. | 282 |
| Lloyd, N. | 292 |
| Ludwig, K. | 287 |
| Macalister, R. A. S. | 332 |
| Madsen, M. | 312 |
| Manley | 287 |
| Markert, F. S. | 282 |
| Matejka, J. | 301, 305 |
| Matschigin, A. A. and Korzuchina, T. | 323 |
| Mayer, R. F. | 288 |
| McDonnell, H. | 273 |
| McVay, T. N. | 320 |
| Mees, C. E. K. | 329 |
| Mehling, C. W. | 282 |
| Meng | 279 |
| Miehr, W., Immke, H., and Kratzert, J. | 297 |
| Mields, M. | 332 |
| Miller, W. J. | 308 |
| Moritz, W. | 314 |
| Munning, A. P. | 322 |
| Naamlooze Vennootschap, etc. | 291 |
| Narracott, P. | 314 |
| Neimann, N. | 314 |
| Neumann, B. | 275 |
| Nitzsche | 278 |
| O. | 284 |
| Offenbacher, L. | 288 |
| Orton, E. Jr. and Krehbiel, J. F. | 294 |
| Osman, A. E. | 318 |
| Owen, W. | 289 |
| Parker | 332 |
| Parker, T. W. and Dartmoor China Clay Co. | 324 |
| Pearson, B. M. | 276 |
| Peiler, K. E. | 290 |
| Perkins, J. L. and Croft, H. D. | 269 |
| Pfeiffer, M. A. | 306 |
| Pickler, O. | 329 |
| Pike, R. D. | 317 |
| Pöschl, V. | 323 |
| Power, H. R. | 270 |
| Preston, F. W. | 285 |
| Priest, I. G. | 275 |
| Quartz et Silice | 304, 305 |
| Redman, L. V. | 330 |
| Rees, W. J. | 302 |
| Richards, C. R. | 331 |
| Richter, G. M. A. | 272 |
| Roberts, S. B. | 285 |
| Rogers, A. F. | 321 |
| Rogers, J. F. and Windett, V. | 317 |
| Rogers, J. S. | 277 |
| Ros, M. | 278 |
| Saxe, C. W. | 304 |
| Schäfer, H. | 278 |
| Schoeller, W. R. and Powell, A. R. | 320 |
| Scott | 314 |
| Seil, G. E. and Heiligman, H. A. | 291 |
| Selényi, P. | 287 |
| Serra, R. E. | 310 |
| Shaw, E. | 329 |
| Singer, F. | 290, 304, 324 |
| Smith | 332 |
| Smith, W. A. | 282 |
| Soubier, L. D. | 289 |
| South Metropolitan Gas Co. and Lamprey, R. H. B. | 304 |
| Stang, A. H. | 293 |
| Stebbins, A. H. | 311, 312 |
| Steger, W. | 297 |
| Stehman, E. H. | 281 |
| Steiner, A. P. | 270 |
| Stoll, K. | 280 |
| Suppes, G. P. | 304 |
| Taylor, C. S. | 328 |
| Taylor, F. P. | 310 |
| Taylor, R. F. | 290 |
| Tenny | 332 |
| Thoenen, J. R. | 302 |
| Thor, P. | 314 |
| Tideswell, E. V. and Wheeler, R. V. | 314 |
| Tone, F. J. | 270 |
| Treischel, C. C. | 305 |
| Trenzen, C. | 291 |
| Troop, R. S. and Wheeler, F. | 308 |
| Turner, W. E. S. | 301 |
| Twyman, F. and Smith, D. M. | 322 |
| Uehling | 315 |
| Ulbrich, P. | 305 |
| Vickers, A. E. J. | 298 |
| Vierheller, H. | 279 |
| Vodicka, A. L. | 281 |
| Wade, C. F. | 326 |
| Walton, E. H. | 287 |
| Weber, F. C. | 316 |
| Wecke, F. | 280 |
| Weicken, C. | 329 |
| Westman, A. E. R. | 325 |
| White, H. E. | 269 |
| Whittier, H. R. | 281 |
| Wickers, E., Gilchrist, R., and Swanger, W. H. | 322 |
| Wilson, R. | 280, 310 |
| Winchell, A. N. | 324 |
| Winder, S. E. and Daubenspeck, H. C. | 288 |
| Windett, V. | 286 |
| Woodall-Duckham, Ltd. and Duckham, A. M. | 318 |
| Woodland, J. E. | 286 |
| Wooley, L. | 294 |
| Wurtz, F. | 273 |
| Wustenfeld, H. | 305 |
| X. | 271 |
| Zelter, W. | 294 |
| Ziegler, G. M. | 331 |
| Zimpelmann, E. | 284 |

## Abrasives

**To mine pumice.** ANON. *Abrasive Ind.*, 9 [2], 33 (1928).—It is reported that a large supply of pumice has been discovered by S. O. Burgdorf, while prospecting in Nevada. Chemists pronounce the material to be of high quality and a company will be formed to develop the article and place it upon the market. P.F.C.

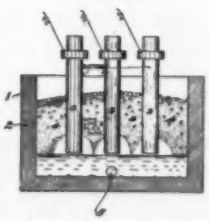
**Use for grit.** ANON. *Abrasive Ind.*, 9 [2], 43 (1928).—An attempt is being made to find a use for the grit from the grinding wheel operations. This grit is composed approximately of 95% low carbon, low phosphorus steel, and 5% abrasive grit. This material seems to accumulate rapidly in tonnage. Some uses already attempted are: (1) wear-resisting cement flooring, composed of half sand and half grit, which is in addition non-skid; (2) cement bricks, which are comparatively heavy and expensive to make in small production. An attempt has also been made to interest the pyrotechnic manufacturers to use the material in "sparklers." An outlet for this material is earnestly sought. P.F.C.

**Abrasive engineering practice.** FRED B. JACOBS. *Abrasive Ind.*, 9 [2], 48–52 (1928). —The economy of disk grinding in the automobile industry is brought out. All the high points of this method of operation are discussed. P.F.C.

**Abrasive engineering progress.** ANON. *Abrasive Ind.*, 9 [2], 59–60 (1928).—Some of the later devlopments in the abrasive industry are discussed. Self-contained roll grinding machine is equipped with hydraulic drive. An abrasive appliance grinds coal by utilizing a series of hammers to break the fuel and grind it into small particles. P.F.C.

**Abrasive engineering progress.** ANON. *Abrasive Ind.*, 9 [3], 87–90 (1928).—Some of the more recent developments are discussed as semi-automatic valve face grinder; improved cylinder wheels; design of skate grinding equipment; a balancing machine; segmental wheel for knife grinder; grinding of saxaphone mouthpieces; belting data. P.F.C.

### PATENTS



**Process for the production of silicon carbide and calcium carbide.** HAROLD E. WHITE. U. S. 1,660,144, Feb. 21, 1928. A new process for the production of silicon carbide, which consists in crystallizing silicon carbide in a calcium carbide slag, hydrating the calcium carbide, dissolving the resultant lime, and removing the silicon carbide crystals from the resultant solution.

**Grinding-wheel dresser.** JULIAN L. PERKINS AND HIRAM D. CROFT. U. S. 1,660,810, Feb. 28, 1928. The combination, in a grinding-wheel dresser, with a bed having an arcuate recess in the top, the chord of the arc being approximately horizontal, of a table having slide-bar grooves therein, and provided with an arcuate recessed and slotted base mounted to move about its axis in the recess in the top, the bottom of the recess in the base being arcuate, and the slot in the base opening above into the 2nd-named recess and below through the underside of the base, a clamp having an arcuate bottom to fit the bottom of the second recess, and a screw passing through the clamp and slot, tapped into the bed, and bisecting the chord and arc, and therefore being approximately vertical.

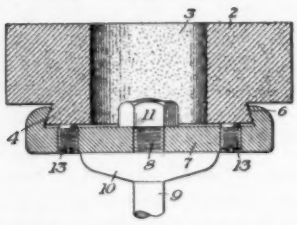
**Truing device for grinding wheels.** CHARLES J. IRWIN. U. S. 1,661,041, Feb. 28, 1928. Truing mechanism having a bar, a housing in which the bar is encased, said bar being both longitudinally and laterally movable in the housing, a dressing point projecting from one side of the bar near one end, a pivot near the opposite end of the

bar, a templet arranged beside and behind the bar fixed relatively thereto, during truing, a contactor projecting from the back of the bar directly behind the dressing point, and means mounted on the housing for sliding the bar longitudinally to cause the dressing point to travel over the surface of the grinding wheel to be trued.

**Grinding machine.** AMOS P. STEINER. U. S. 1,662,546, March 13, 1928. In a grinding machine, abrading means, work-holding means, a carriage for one having traversing movement relatively to the other, a workholding magazine, means for successively feeding unfinished articles from the magazine to the workholding means, a fluid motor for operating the feeding means, and connections whereby the traversing carriage sets the motor in operation at predetermined times, substantially as set forth.

**Abrasive composition.** HENRY R. POWER. U. S. 1,661,849, March 6, 1928. A paste for metal grinding formed with an inorganic material having a high absorptive power and having a granulated abrasive material incorporated therein, the paste also containing glycerine and being free of silicate of soda.

**Grinding wheel and holder therefor.** FRANK J. TONE. U. S. 1,661,861, March 6, 1928. A grinding wheel assembly including an abrasive wheel formed of bonded abrasive grains having an integral hub portion of reduced diameter thereon, a series of lugs disposed around the periphery of the hub portion, the peripheral surface of each lug being undercut, each lug also being outwardly curved from one end toward the other, and a metal holder secured to the hub portion having a central portion with a series of undercut lugs on the face thereof corresponding to the lugs on the hub portion of the wheel, the lugs on the holder being adapted to embrace and interfit with the lugs of the hub portion and to be forced into wedging relation therewith.




**Sizing device for internal-grinding machines.** AMOS P. STEINER. U. S. 1,662,213, March 13, 1928. The combination with a grinding machine having a work-holding chuck, of a water guard around the chuck and a hydraulic sizing device carried by the water guard and means controlled by the movement of the grinding machine carriage for moving the sizing device into and out of operative position, substantially as set forth.

**Internal-grinding machine.** ALDEN M. DRAKE. U. S. 1,662,240, March 13, 1928. An internal grinding machine comprising a frame, a work-supporting spindle having a relatively large axial opening therethrough, and being adapted to receive and support a piece of work at the front end thereof having a cylindrical opening aligned with the spindle opening and of less internal diameter, a bearing support for the spindle, a grinding wheel, a wheel shaft, a wheel head mounted on the frame at the rear of the work spindle with the wheel shaft projecting into the axial opening, the wheel adapted to enter and leave the work from the rear side thereof, means to cause relative axial movement of the wheel and work, and a size indicating device also extending through the spindle into the work from the rear and effective to give an indication of the internal diameter of the work during the grinding operation, the axial opening through the spindle being of a size sufficiently large to freely receive the grinding wheel and indicating device.

**Method and apparatus for grinding internal surfaces.** ALDEN M. DRAKE. U. S 1,662,241, March 13, 1928. In an internal grinding machine, a frame, an annular work-supporting member, a bearing support therefor, means to secure the work to the member, a grinding wheel, a wheel head positioned at the rear of the work-supporting

member, a wheel shaft mounted in the head and projecting therefrom into the work-supporting member to present the wheel at the rear face of the work, a truing device for the wheel at the rear of the work, and means to cause relative axial travel between the wheel and work, the truing device being positioned between the work and the wheel head and being continuously spaced rearwardly from the rear face of the work a distance greater than the axial width of the grinding wheel face.

## Art

**Design of printed table ware.** CHARLES F. BINNS. *Bull. Amer. Ceram. Soc.*, **7** [4], 75–77 (1928).—The situation of the American table ware industry in satisfying the requirements of the best domestic use and in meeting the competition of foreign importations is frankly discussed. The possibility of improving the present situation by employment of designers or by selection of submitted designs is advanced and the advantages and disadvantages of these methods are cited. E.J.V.

**The Art Division, 1928.** E. DEF. CURTIS. *Bull. Amer. Ceram. Soc.*, **7** [3], 45–49 (1928).—Various points that have drawn the attention of ceramic artists are briefly discussed and ways in which the Art Division could be of assistance are suggested. These include (1) grade school education (2) vocational training, (3) the professional craftsman, (4) the nonprofessional craftsman, (5) normal and teacher training courses, and (6) schools of industrial art. E.J.V.

**Artistic mirrors.** X. *Diamant*, **49** [10], 192 (1927).—A brief discussion of various types of mirrors, artistically decorated with enamels and in natural colors. E.J.V.

**Color study of glass windows in French cathedrals.** ANON. *Diamant*, **49** [10], 192 (1927).—A brief report of an interesting study of colored glasses in French cathedral windows, made by some of the German stained glass workers. E.J.V.

**The revival of the glass painting art.** W. BLOSSFELDT. *Diamant*, **49** [11], 203–205 (1927).—A discussion of the art of stained glass window production. Erhard Klonk is an artist who produces stained glass windows for banquet halls and homes and is also proficient in the production of church windows. E.J.V.

**The manufacture of stained glass in the 16th Century.** K. H. *Diamant*, **49** [12], 229–30 (1927).—A brief abstract from a manuscript written in 1519, dealing with the primitive methods of producing stained glass practiced then. E.J.V.

**Defect phenomena in glass etching.** ANON. *Diamant*, **49** [13], 246–47 (1927).—A discussion of various defects which are apt to occur in glass etching. These include the starting of small sandlike pits and spots on the ware due to the discharge of alkali salts from the glass, another defect due to the wrong standardization or strength of the etching medium, etc. The methods to be followed to produce good etched glass are described. E.J.V.

**Stained glass of Ludwig Preckel, Cologne.** ANON. *Diamant*, **49** [15], 286 (1927). —A discussion of some of the stained glass productions of Ludwig Preckel, of Cologne. E.J.V.

**On the question of quality and development in glass staining.** X. *Diamant*, **49** [15], 290–93 (1927).—A practical discussion for the layman, dealing with the art of stained glass production. E.J.V.

**Color measuring apparatus.** ANON. *Diamant*, **49** [16], 306 (1927).—A description of the trichromate colorimeter constructed by J. Guild of the National Physical Laboratory in London. Its particular advantages are pointed out, and an idea of the principles involved is given. E.J.V.

**Les Verreries de Jean Luce.** RENÉ CHAVANCE. *Art et Dec.*, **32**, 17–24 (1928).—Mr. Luce in 1913 displayed designs in glass enamels and decorations by hand with glass paste. He later used the engraver's wheel which he found impractical due to the impossibility of executing certain designs and the length of time for execution. For about

five years he has adopted a method similar to the acid process in etching and has secured new effects through the sand blast, using a brush with a pressure of 3 kg. per sq. cm. His designs ars geometrical and interesting because of their interpretation without perspective. He conventionalizes the plant until it becomes an abstract figure. From this to the primitive form of decoration there is but one step and Luce has overcome this by adopting some of the forms of "Croisiere Noire." His effects on polished surfaces have a precious quality, in black and brilliant color or in somber gray. The incising to a lower level of a different color forms irregular planes and creates a variation even in the pieces of the same form. It is, nevertheless, in the white glass which catches the light and reflects ths prisms, that he has been able to get his best effects. M.G.W.

**Sybyl Fennimore's pottery.** ANON. *Creative Art*, **2** [1], 32–33 (1928).—Sybyl Fennimore, a student, considered one of the ablest members of the L. C. C. Central School of Arts is exhibiting, at Southampton Row, modeled and turned pieces with free decoration and unusual craftsmanship. The Central School has recently introduced a high temperatured kiln for the production of stoneware. M.G.W.

**London Autumn Exhibition.** ANON. *Creative Art*, **2** [1], 44–46 (1928).—British Pottery Exhibition at Victoria and Albert Museum is under the auspices of the British Institution of Industrial Art. It is an admirable exhibit of potters' art, pleasant, unassuming table ware, and unusual tile at moderate prices. M.G.W.

**A Corinthian krater.** CHRISTINE ALEXANDER. *Bull. Met. Mus. Art*, **23** [2], 48–49 (1928).—Vases which were produced in the early part of the 6th Century B.C., decorated with mythological scenes, close the long story of Corinthian pottery. A few of a series of great kraters have survived and the Museum has just acquired one of them. The back of the vase is occupied by a procession of mounted warriors and a frieze of lionesses and grazing goats. The center of interest is a fine chariot scene which the painter has raised from the genre into the realm of myth by inscribing the names of Homeric personages. The composition is that of a frieze, the heads of all the persons brought to the same level even at the expense of having to make the two principals, standing in the chariot, shorter than the rest. At one point the artist has shown six figures, the four horses, the charioteer, and his companion, one behind the other, by simply superposing their silhouettes, without loss of decorative effect. The reconstructed drawing of the principal scene shown is by Lindsley F. Hall of the Museum staff. A.A.A.

**A newly acquired loutrophoros.** GISELA M. A. RICHTER. *Bull. Met. Mus. Art*, **23** [2], 54–57 (1928).—The Athenian graveyard of the 6th Century B.C. must have had a variety of monuments, mostly tall narrow slabs with representations of the departed, statues in the round of the Apollo type, and also slender terra cotta vases of distinctive shapes placed on top of low mounds, each with a funeral scene painted in black, white, and purple on the red clay. The Museum has just acquired an example of such a vase exceptionally well preserved, the best example in the black-figured technique that has survived. It is decorated, front and back, on both neck and body with the ceremonial scenes which preceded a Greek burial. *Loutrophoros*, the Greek name for these vases, means "bath," and is derived from the custom of carrying water in such vases for the nuptial bath. Such vases were also erected on tombs of those who died unmarried. Vases of this form in the black-figured technique are rare; in 1894 there were only 11 known. In the Museum collection there are two of average workmanship, both fragments. A.A.A.

**Coloring effect of selenium on glass.** ANON. *Ceram. Ind.*, **10** [3], 314 (1928).—The effect of metallic selenium on glass varies according to the composition of the latter. It produces a brown cast in soda glasses and pink or red in potash glasses. Boric acid encourages the development of the pink color. Potassium nitrate and arsenious oxide

counteract selenium slightly. The effect of potassium tartrate depends upon the constituents of the glass. F.P.H.

**Coloring glass with phosphates.** ANON. *Ceram. Ind.*, **10** [3], 314 (1928).—With glasses of the type (1) $K_2O \cdot RO \cdot 3SiO_2$, or type (2) $K_2O \cdot RO \cdot 0.5\ B_2O_3 \cdot 3\ SiO_2$, variation in the kind of alkalis has no effect upon the coloration produced by bone ash. Boric acid intensifies the action of bone ash. Lead, barium, and zinc glasses are influenced in this order. The RO content has a great influence upon borosilicate glasses. The phosphate $Na_2HPO_4$ acts similarly to bone ash. With calcium phosphate $Ca_3(PO_4)_2$ in glasses of the first type, lead favors opalescence most, followed by barium. In glasses of the second type, lead and barium aid the action of the phosphate, zinc being less active. The coloring power of $Na_2HPO_4$ is weaker than that of the other two agents in glasses of the second type, but no remarkable difference is observed in the first type. Opalescence appears to be due to the suspension of $P_2O_5$. F.P.H.

**Mat glazes.** F. WURTS. *Keramos*, **6** [12], 469–70 (1927).—The following colorless mat glaze formulas are given as examples of those successfully used in practice.

TABLE I

| No. | Cone | $Na_2O$ | $K_2O$ | CaO | ZnO | MgO | PbO | $Al_2O_3$ | $SiO_2$ | $TiO_2$ | $SnO_2$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 07 | | | .04 | .46 | | .5 | .07 | .97 | | |
| 2 | 07 | | | .08 | | | .92 | .14 | 1.8 | .22 | .12 |
| 3 | 05 | | | | | | 1.0 | .3 | .6 | | |
| 4 | 03 | .05 | .1 | .33 | | .15 | .37 | .13 | 1.0 | | |
| 5 | 1 | | .1 | .33 | | .17 | .4 | .18 | 1.3 | | |
| 6 | 4 | | .15 | .35 | | .20 | .30 | .28 | 1.56 | .37 | |
| 7 | 7 | | .25 | .60 | | .15 | | .40 | 2.20 | | |
| 8 | 9 | | .30 | .65 | | .05 | | .45 | 2.50 | | |

The following percentages of coloring oxides added to the above glazes given the indicated colored mat glazes.

TABLE II

| No. | Color | CuO | CoO | $TiO_2$ | $NiO_2$ | ZnO | $SnO_2$ | $Fe_2O_3$ | $Mn_2O_3$ |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Gray-green | | .5 | 10 | 1.5 | | 2 | | |
| 2 | Violet-gray | | | 5 | | | | | 5 |
| 3 | Blue-green | 4 | 1 | 5 | | 2 | | | |
| 4 | Steel-blue | | .5 | | 1.5 | | 2 | | |
| 5 | Red-brown | | | 3 | | | | 6 | 3 |
| 6 | Ivory | | | 9.5 | | | | 2 | |
| 7 | Gray-blue | | 1.3 | 10 | | | | | |
| 8 | Mat gray-green | | | | | 5+1% $Cr_2O_3$ | | | |

F.P.H.

**Painting ceramic ware.** ANON. *Keramos*, **6** [12], 475–76 (1927).—The second of a series of articles on this subject. This article deals with underglaze painting on stoneware. Formulas for glazes and colors are given. See *Ceram. Abs.*, **7** [1], 5 (1928). F.P.H.

**Malabry Court, Chicago.** ANNE LEE. *Arch. Rec.*, **63** [2], 97–104 (1928).—The open slate paved court yard is surrounded on three sides by red brick white coated walls of a quaint house with slanting roof of hand made tiles of henna, brown, and purple. A glazed panel furnishes an emergency fire exit through the rear apartment. E.B.H.

**Modern china rivals the old.** FLORENCE S. CLARKE. *Arts and Dec.*, **28** [5], 66 (1928).—Famous old chinaware and porcelains still popular include Wedgwood, Minton, Doulton, and Beleek. Traditions and many original patterns preserve the spirit of graceful shapes and rare decorations, though the modern china is more gorgeous in color. Lenox and Haviland are mentioned as inspired by these old wares and rivaling them in lightness and beauty. E.B.H.

**English influence in rough stucco construction.** HUNTER MCDONNELL. *Arts and*

*Dec.*, **28** [5], 71 (1928).—A pleasing combination of building materials includes native stone pillars, plaques of stucco carving on the walls, decorative brick work, variegated slate in roof and flagstones, and textured plaster. E.B.H.

**L'art modern in lighting.** MARY BARBARA DENNIS. *Arts and Dec.*, **28** [5], 74 (1928). —In no other field of interior decoration have greater strides been made than in lighting and its equipment. A lantern seeming to grow out of the ceiling is of slabs of opalescent glass, one fitted inside another so that the light is diffused to every corner of the room with no glare. The pineapple motif is used in a center light of glass and metal. A fixture scientifically arranged to throw light over the entire room with no strain on the eyes has three electric candle lights shielded by a circular shade of opaque glass. Some brackets are of fantastic modern design and table lamps are miniature, naturalistic forms. An interesting standing lamp five feet high is of a triangle of polished iron set on a stand of three piled up squares of iron. Inside the triangle is set a slab of opalescent glass through which the light shines up and out from concealed bulbs at the base. E.B.H.

**Heraldic designs in stained glass.** IDA J. BURGESS. *Int. Stud.*, **89** [369], 65–69 (1928).—This fully illustrated article traces the use of heraldry in stained glass windows as family signatures as well as decoration, dating from 1530 through the Middle Ages. E.B.H.

**Buen Retiro.** CHARLES HYDE-JOCELYN. *Int. Stud.*, **80** [369], 70–73 (1928).—The porcelains of the 18th Century are scarce in American collections. Buen Retiro (La China) Spain's royal porcelain, established by Charles III (inspired by Capo di Monte) and restricted during his 30-year reign to royal patronage is the most important. At first assisted by Italian workmen and molds, the work was much superior to the later varieties which compare badly with other European aesthetic perfection. The use of porcelain for large areas such as ceilings, etc., became popular in Spain, also vases 6 feet or more high. The Italian fleur-de-lis first used as a mark was replaced by interlaced C's. The forte of the Spanish craftsmen lay in plastic work rather than the making of dishes. Toward the end of the 18th Century Wedgwood ideas were adapted but lacked purity in color. Vases inspired by Adam destroyed purity of outline by adding finials of bouquets, etc. After the destruction of the factory during the Napoleonic wars, the attempt was made to revive the industry but with no marked successes. E.B.H.

**Illustration.** *Int. Stud.*, **89** [370], 20 (1928).—Rockingham porcelain oviform vase with painted panels. E.B.H.

**Work in stained glass art.** BALANO. *Amer. Glass Rev.*, **47** [18], 36–37 (1928). —Stained glass, with its lure of color and its thousands of pieces of exquisite glass all welded into some intricate design presents many opportunities to the woman of today. The student in art and her connection with the industry are discussed. Some of the business and manufacturing problems that come to light in the industry are discussed P.F.C.

**Worth-while dinnerware.** ANON. *Pottery, Glass, and Brass Salesman*, **37** [4], 30 (1928).—Excellent and salable showings of glass and other lines now being offered to the trade by manufacturers and importers. Carrollton Pottery Co. is putting on the market several designs that are quite distinctive and are made especially attractive by the ivory luster rim used. There is about this one pattern a suggestion of Chippendale. The feature of the decoration is an elongated motif of irregular outline. Several designs and color schemes are described. P.F.C.

**Many buyer-tempting offerings.** ANON. *Pottery, Glass, and Brass Salesman*, **37** [4], 31 (1928).—The Fostoria Glass Co., Herman C. Kupper, Inc., Werner & Kartiganer, handling products from Silver City Glass Co., and Cannonsburg Pottery Co.,

all offer new products in china and glassware that are thought to be noteworthy for their quality and novelty. P.F.C.

**Attic and Etruscan pottery at the necropolis of Spina.** F. HALBHERR. *Illust. London News*, **172**, 296–97 (1928).—A necropolis extraordinarily rich in pottery has been found in the territory of the Felsinian or North-Eastern Etruscans at Valle Trebba, in the lagoon of Comacchio, near Ravenna, on the site of the ancient commercial town of Spina. Photographs show 3 amphorae, 2 winejars, a waterjar, and a kylix, in exquisite Attic designs, and an Etruscan vase of a kneeling bull, with handle on the back of the animal, and a horse's head libation cup. In connection with these finds, it is noted that Alfredo Trombetti, of Bologna, claims to have discovered the clue to the lost Etruscan language. H.H.S.

**Ossarn pottery: relics of an unknown phase in pre-history.** J. BAYER. *Illust. London News*, **172**, 438–39 (1928).—At Grasberg, near Ossarn, in the district of Herzogenburg in Lower Austria, there is a large Neolithic settlement, now being excavated by B. The pottery has several peculiar and distinctive forms hitherto unknown to archaeologists. One vessel found has pins, or pivots, on its inner surface. Another has holes bored through the top and is clearly intended for suspension, but has perforations at the base. The ornamentation is of patterns with lines and angles and impressed dots, some of the dots being filled with paste. The general type is that of the "band-handle ceramic culture," and Ossarn civilization is therefore dated to 2500 B.C. In one of the pits unearthed were found evidences of cannibalism; there were burned remains of a person aged 15 and the pottery plates (with handle shaped like the horns of a moon) which may have been used during the meal. Six photographs. H.H.S.

**The Kern Institute of Asiatic Archaeology, Leyden, Holland.** J. H. KRAMERS. *Jour. Calcutta Hist. Soc.*, **33**, 83 (1927).—A research institute has been founded at the Univ. of Leyden, and named after the great Dutch orientalist Kern, for the study of the art, applied art, and art history of southern Asia and the islands of the Indian Ocean. Students from abroad who wish to avail themselves of the facilities offered are cordially welcomed, and authors of papers on these and allied subjects are asked to supply the Institute with copies of their publications. H.H.S.

**Colorimetry.** IRWIN G. PRIEST. *Science*, **67**, 39–40 (1928).—In connection with the work of the colorimetry section of the Bureau of Standards and the report of the colorimetry committee of the Optical Society of America, P. is compiling a bibliography on the subject, and requests authors to address him at the Bureau of Standards, Washington, D. C. The following subjects are mentioned as illustrative of the classes of material desired: color of daylight and artificial light, visual psychophysical data, theories of color vision, trilinear coördinates, measuring instruments and methods, color standards and nomenclature, reflection, turbidity, and scattering of light. H.H.S.

**The snake motive in Brazilian art.** AUGUST HERBOTH. *Sprechsaal*, **61** [1], 1–2 (1928).—A discussion on primitive Brazilian pottery using the snake motive. Many illustrations are given. R.A.H.

**Glass used in decorative arts.** ANON. *The Christian Science Monitor*, Feb. 27, 1928.—A description is given of the works of René Lalique, Boris Lacroix, and M. Damon, modern French workers in glass, which were displayed at the Autumn Salon at the Grand Palais in Paris.

**Antique glasses. III. Assyrian-Babylonian glasses.** BERNHARD NEUMANN. *Zeit. f. angew. Chem.*, **41** 203–204 (1928).—Fragments of glass vessels collected by the Univ. of Pennsylvania expeditions to Babylonia in 1888, 1889, 1890, and 1893–96 were analyzed by N. These glasses can be classified into three types; (1) bluish green, (2) rose, usually pale, (3) blue. The fragments selected for analysis were; No. 89, the deepest rose; No. 90, a paler rose; No. 91, the darkest green; No. 92, a paler green; No. 93, the darkest blue; and No. 94 a lighter blue. The analyses are:

| | Rose | | Green | | Blue | |
|---|---|---|---|---|---|---|
| | 89 Deep rose | 90 Pale rose | 91 Dark green | 92 Light green | 93 Dark blue | 94 Light blue |
| $SiO_2$ | 71.14 | 69.82 | 63.10 | 61.18 | 64.41 | 65.38 |
| CaO | 5.26 | 5.79 | 7.66 | 7.10 | 7.53 | 6.10 |
| MgO | 5.40 | 4.09 | 3.42 | 4.92 | 4.59 | 5.50 |
| $Al_2O_3$ | 2.48 | 1.40 | 2.75 | 2.06 | 2.58 | 1.50 |
| $Fe_2O_3$ | 0.72 | 1.80 | 1.76 | 2.15 | 1.44 | 1.54 |
| $Mn_2O_3$ | 1.04 | 0.41 | 5.92 | 4.37 | 2.75 | 0.99 |
| CuO | 0.55 | 0.36 | 1.02 | 0.52 | 1.20 | 1.48 |
| $K_2O$ | 1.30 | 2.18 | 3.18 | 2.88 | 2.08 | 2.48 |
| $Na_2O$ | 10.81 | 13.51 | 9.35 | 12.90 | 12.75 | 13.55 |
| $SO_3$ | 0.87 | 0.96 | 1.52 | 1.67 | 1.00 | 1.19 |
| | 99.57 | 100.02 | 99.68 | 99.73 | 100.33 | 99.71 |

As compared with the ancient glasses of Samaria and Alexandria, the alkali of these glasses is much lower, indicating a rather high degree of technical skill and knowledge. Glasses of closely related colors are nearly the same in composition, those of different colors differ widely in composition. All the analyses show $Mn_2O_3$ and CuO, even in the rose glasses. The rose color is probably due to manganese, the green and blue to copper and manganese. Neither cobalt nor lead was found. The fragments are very evidently blown ware. Their date is about 250 B.C. It was previously supposed that blown glassware was not made before 20 B.C. H.I.

**Ceramic glazes and enamels II.** B. M. PEARSON. *Ceram. Age*, **10** [6], 214–18 (1927).—(1) *Natural opaque glazes.* With these, opacity is a function of the glaze as a whole. P. gives formulas and batches for two opaque glazes of this kind. Titanium oxide is a good opacifying agent but should not be used in excess. Three formulas are given. For mat or crystalline glazes the formulas are altered so that simple silicates are present in excess and crystallize out. The fusing temperature of the silicate in excess should be fairly low. The glaze should be held at the maximum maturing temperature to promote fusion, then cooled to the crystallizing temperature and held there until sufficient crystals are formed, when it can be cooled further. Formulas for two crystalline glazes producing good effects at cone 11 are given. (2) *Adventurine glazes.* Colored oxides are used and crystallization in thin plates or spangles induced. The composition should be so balanced that the glaze is sufficiently fluid for the crystallization to take place. Several formulas and references are given. (3) *Colored glazes.* The principal coloring oxides are listed. Formulas and methods of preparation are given for Rockingham brown, yellow, red, blue, and green glazes. The preparation of materials for colored glazes is described and methods for preventing pin holes are discussed. (4) *Chemical resistance.* Reference is made to a report of the Foods Division of the Ministry of Health, England. Formulas for satisfactory glazes are given. Lead glazes are fairly resistant to the solvent action of foodstuffs under ordinary conditions but lead may be dissolved to a dangerous extent if they are subjected to the prolonged action of acids. (5) *Enamels for glass.* These must fuse at a temperature below that required to deform the glass article, the glazes being fired to about 650°C. A large number of Pringer's formulas for fluxes and glass painting enamels is given. (6) *Red etching of glass.* Three firings are necessary for this process, the first and third being oxidizing and the second reducing. A paste is applied before the first heating and removed before the second firing. A ruby tinge is produced. Formulas for pastes are given. (7) *Resinate glazes.* Compounds of the heavy metals known as resinates are used extensively for body decoration, producing lusters which may be either colored or colorless. P. gives formulas and methods for producing lusters of different kinds including mother-of-pearl, colorless, and colored lusters. For Part I see *Ceram. Abs.*, 7 [2], 88 (1928).

PATENT

**Process of making decorated glassware.** MARTIN L. BURGESS. U. S. 1,662,295. March 13, 1928. The process of producing a two-tone color effect in glassware, which consists in subjecting a plate of glass of uniform color throughout and while hot to a roll having a pattern etched thereon.

## Cement, Lime, and Plaster

**Plastic magnesia cements.** ANON. *Rock Prod.*, **31** [3], 33 (1928).—If magnesite is heated to higher temperatures and for longer periods of time than are required to produce a material suitable for use in magnesia cements it approaches a "dead burned" condition, which is the type of product employed in the form of blocks and bricks for many furnace and kiln linings. As used in the Sorel reaction, the oxide is in the condition known as caustic or plastic calcined magnesia. This term gives rise to the name "plastic magnesia cements," which is often used instead of the longer description, "magnesium oxychloride cements." Before the plastic magnesia can be used in stucco, flooring, or other cement products, it must be very finely ground; in a good commercial product 75% or more will pass a 200-mesh sieve. Because of the great strength and binding properties of magnesium oxychloride, it is an ideal material for cementing together tough and fibrous fillers to form a resilient, wear-resisting floor. The first of such floors was installed in this country more than 20 years ago, and as time has passed the technic of both manufacture and installation has been improved, until today architects and builders recognize magnesia composition flooring as a standard type which possesses many merits. Chief of the advantageous qualities of these floors are their resiliency, sanitary properties, and attractiveness. Floor and wall tile, both cast and pressed, are being prepared from these cements with very satisfactory results. Statuary and other ornamental ware have likewise been cast with excellent result. Magnesia cements are particularly adaptable for casting because they have a slight tendency to expand in the molds during setting, thereby accurately reproducing even the finest lines of the mold. A very fire-resistant paint to be applied over wood surfaces may be made with oxychloride cement as the binder. F.P.H.

**Manufacture of gypsum plasters.** W. B. LENHART. *Rock Prod.*, **31** [3], 43–47 (1928). F.P.H.

**Composition of commercial chemical limes.** J. S. ROGERS. *Rock Prod.*, **31** [3], 60–61 (1928).—Analyses of 22 samples are given. F.P.H.

**Portland cement.** ANON. *Rock Prod.*, **31** [3], 77 (1928); *Zement*, **16**, 974–77 (1927). —The importance of working out uniform methods was recognized early by the American Chemical Society and by scientists in France, Germany, and Austria. The present tests were made to compare the results of four operators and the numerical values of determinations of silica and sesquioxides by two different procedures. Portland cement from a shaft kiln and pure chemicals were used in the tests. F.P.H.

**Lime burning practice. II. Heat distribution in lime kilns, gas flow, lime flow, causes of irregular flow.** VICTOR J. AZBE. *Rock Prod.*, **31** [4], 66–67 (1928).—For part I see *Ceram. Abs.*, **7** [4], 212 (1928). F.P.H.

**German lime industry in 1927.** ANON. *Rock Prod.*, **31** [4], 80 (1928); *Baumarkt*, **50**, 1528 (1927). F.P.H.

**Artificial stone from blast-furnace slag.** ANON. *Stahl und Eisen*, **47**, 1909–10 (1927); *Rock Prod.*, **31** [3], 76–77 (1928).—Pig iron slag or basic slag from steel furnaces is ground to a fine powder in edge-runner mills with just sufficient water to produce a plastic mass. During grinding, ammonia and hydrogen sulphite are evolved and hydrolysis of some of the constituents of the slag takes place, so that the resulting mass is endowed with setting and hardening properties like cement. The mass is mixed

with a proportion of sandy slag and with 2.5% of cement, and the mixture is pressed into blocks, which are set aside to harden for 8 to 10 weeks. Very basic slags are preferably mixed with a certain quantity of acid slag to reduce the basicity during the grinding operation. F.P.H.

**Constitution of Portland cement.** HANS KÜHL. *Tonind. Ztg.*, **51**, [80], 1455–56 (1927).—A discussion of the work of Hansen, Dyckerhoff, Ashton, and Bogue (see *Ceram. Abs.*, **6** [7], 305 (1927)) on the constitution of Portland cement is given. The question of the existence or nonexistence of the compound $8\ CaO \cdot 2\ SiO_2 \cdot Al_2O_3$ is discussed in the light of the work of the above-mentioned investigators. F.P.H.

**Composition flooring of cement and wood and its foundation construction.** HANS SCHÄFER. *Tonind. Ztg.*, **51** [84], 1531–32; [86], 1567–68 (1927).—The preparation and properties of magnesium oxychloride cement are described. The properties of the foundation for this type of flooring are discussed. F.P.H.

**Corrosion of concrete by sewer gas.** HERBERT AND IRWIN BRINTZINGER. *Tonind. Ztg.*, **51** [85], 1546–47 (1927). F.P.H.

**Properties of Portland cement.** HAEGERMANN. *Tonind. Ztg.*, **51** [86], 1561–64; [87], 1577–80 (1927).—An address delivered before the German Portland Cement Association at its 50th Jubilee meeting and at the International Congress for Testing Materials at Amsterdam. The changes in chemical composition and physical properties of Portland cement that have taken place during the past 35 years are traced. The physical properties considered are: (1) tensile strength, (2) compressive strength, (3) fineness. F.P.H.

**Hypotheses of present cement testing.** OTTO GRAF. *Tonind. Ztg.*, **51** [86], 1564–65 (1927).—G. determines the variation of compressive strength of neat cement and of mortars with lime. The mortars used consisted of (*a*) 1 part cement, 2 parts sand, (*b*) 1 part cement, 3 parts sand, and (*c*) 1 part cement, 4 parts sand. A method of determining the consistency of mortars is described. F.P.H.

**The rotary kiln in the lime industry.** THEODOR KLEHE. *Tonind. Ztg.*, **51** [88], 1602–1604 (1927); *Rock Prod.*, **31** [3], 76 (1928).—In adapting a rotary kiln to lime burning, care should be taken to provide means of cooling the gases immediately upon decarbonation. For economy, no foreign material such as steam can be used to cool the hot gases. This problem was solved and patented by Ferd. Meyer, (Ger. 207,881), as a process wherein the burned lime is made to cool the gases. Meyer resorted to the original form of the rotary kiln using three separate inclined tubes each above the other. In the first, or upper tube, the raw material is preheated and dried by the escaping gases. Decarbonation takes place in the second and cooling in the third or lowest kiln. Cooling is accomplished by an air current passing over the hot lime, becoming preheated and then being led to the combustion chamber for mixture with the hot gases. The combustion of the fuel, whether pulverized coal or producer-gas, takes place in a separate combustion chamber, instead of in the kiln as in the cement industry. The gases traverse the kiln in the same direction as the charge. The temperature of the kiln can be regulated by admitting larger charges, which immediately reduce the temperature of the gases. F.P.H.

**Proportioning cement raw materials.** NITZSCHE. *Tonind. Ztg.*, **51** [90], 1640–42; [98], 1774–76 (1927).—Methods of calculating the batch compositions for cement of a definite composition from raw materials of a definite composition are given. F.P.H.

**Standard strength tests on cements.** M. ROS. *Tonind. Ztg.*, **51** [91], 1655–58 (1927); [92] 1673–76 (1927).—An address delivered before the International Congress for Testing Materials at Amsterdam. The standard methods of determining tensile strength, compressive strength, and cross-breaking strength are described and the effect of the water content of the mortar on the change in these values with time are shown

for some typical cements. The specific gravity and specific volume of a number of European cements are given. F.P.H.

**The water-cement factor in the compressive strength of concrete.** MENG. *Tonind. Ztg.*, **51** [91], 1660–61 (1927). F.P.H.

**Belgian standards for cement.** ANON. *Tonind. Ztg.*, **51** [96], 1737–40 (1927). F.P.H.

**Gypsum as a building material.** K. LADE. *Tonind. Ztg.*, **51** [97], 1753–54 (1927). F.P.H.

**Questions on cement.** HANS KÜHL. *Zement*, **16**, 200–201 (1927); *Rock Prod.*, **31** [4], 64–65 (1928).—A list of 50 questions on cement which have not received satisfactory scientific explanation is given by K. F.P.H.

**Effect of cold water on alumina cements.** H. VIERHELLER. *Zement*, **16**, 998–99 (1927); *Rock Prod.*, **31** [3], 77 (1928).—Tests were made by V. of standard specimens of alumina cement exposed to very low temperatures immediately upon filling the molds. It was found that all of the mixing water froze before initial set took place, the cubes gaining their usual strength only upon thawing of the ice crystals. When large specimens are used, the effect of low temperature is reduced, as large masses of concrete develop considerable heat during hardening which counteracts to a certain extent the effect of freezing. A 30-cm. cube of 1 part alumina cement and 3 parts standard sand mixed with 8.75% water and tamped into an ordinary wooden form $2^1/_2$ cm. thick was exposed immediately upon tamping to temperatures of 6–8°C. The surface of the cube was covered with paper and a layer of sand 2 cm. thick. After $2^1/_2$ hr. the lowest temperature of the cube was reached at 6.7°C. Start of setting raised the temperature to 27°C. After 14 hr. the temperature at a point 5 cm. from the surface of the cube was 9°C, the surrounding temperature being 8.5°C. Only at the end of about $17^1/_2$ hr. did the temperature drop to zero. At that time hardening of alumina cement had already progressed for some time, the temperature of the setting concrete ranging from 70–27°C, these temperatures satisfying the strictest requirements. After 24-hr. exposure to freezing the specimen showed perfect hardening when the form was removed. In spite of imperfect surface of the form, the cube, when tested, yielded a compressive strength of 4950 lb./in. after 10-day exposure to freezing. The author's conclusions are that alumina cement differs from high strength Portland cement in that its set is less influenced by low temperatures. F.P.H.

**Cement industry in Dalmatia.** O. KALLAUNER. *Stavivo*, p. 44 (1926).—In the surroundings of Spalato in Jugoslavia are five large Portland cement factories with a total daily output of 1800 T. There are large quarries on the coast exporting raw materials to cement factories in Italy. These raw materials consist of homogeneous lime slate, the layers of which are 100 m. thick. The lime slate contains 75.8–76.8% $CaCO_3$ and is therefore suitable for fabrication of natural cement. The above-mentioned factories are exporting cement to Egypt, Greece, Sicily, the Orient, South America, etc. The largest undertakings are "Majdan" and "Titan." K. believes it possible to produce at Spalato also the melted cement, and also alumina cement in the district of Sebenico-Knin where is to be found bauxite containing 55–60% $Al_2O_3$. BA.

**A suggested standard method of slaking in testing building limes.** A. D. COWPER AND J. F. WILLIAMS. *Chem. and Ind.*, **47T**, 31–35 (1928).—The qualities desirable in a lime are high volume-yield, high plasticity, and high sand-carrying capacity. The two latter qualities are considered in practice to be closely associated with the first, and a method is therefore worked out to determine the volume-yield. The quicklime sample is crushed to $^1/_5$ inch size and "isothermal" slaking is carried out in a large excess of water at two temperatures, (*a*) at 50°, (*b*) at boiling point. The better result of these two tests is taken as the volume-yield. A maximum volume-yield avoids "drowning"

and "burning." Neither of the two temperatures may be the best for a particular lime; a manufacturer is therefore at liberty to specify his own temperatures. H.H.S.

**Colors for Portland cement mortar.** RAYMOND WILSON. *Proc. Amer. Concrete Inst.*, **23,** 28 pp. (1927).—Tests were made of the effect of pigments, representative of those now on the market, on the color and compressive strength of white and gray mortars, and on the permanence of the color after 6 months exposure. Organic colors are not suitable for general use in cements, nor are cadmium lithopone or zinc chromate. The following types are suitable: Buff, yellow, red: iron oxide pigment; green: $Cr_2O_3$; blue: ultramarine; brown: iron oxide, or iron and Mn oxide, pigments; black: iron oxide, $MnO_2$, carbon black, bone ash, and the so-called mineral blacks (coal, coke, and certain carbonaceous material high in mineral matter). Quantitative color measurements were made by the Munsell apparatus, and it was found that the color as expressed in terms of the Munsell system is proportional to the logarithm of the quantity of the pigment. Ten per cent is recommended as the general limit of the amount of pigment in the mortar, but admixtures up to 20% of iron oxides and $Cr_2O_3$ resulted in an increased 28-day strength. Iron oxide black is preferable to carbon black since equally dark colored mortar with less reduction in strength may be obtained. H.H.S.

BOOKS

**Handbook of Cement Literature.** FRIEDRICH WECKE. Zementverlag, Charlottenburg. 1447 pp. (1927). 40 RM. *Tonind. Ztg.*, **51** [92], 1685 (1927). F.P.H.

**Action of Silicic-Acid Admixtures to Cement on the Physical Properties of Concrete.** R. GRÜN, W. BECKER, H. BUCHHOLTZ. Berlin-Charlottenburg (Zementverlag) 35 pp. *Tonind. Ztg.*, **51** [91], 1665 (1927). F.P.H.

PATENTS

**Glazing stone surfaces.** K. STOLL. Brit. 282,786, Feb. 22, 1928. A glazelike surface is produced on stone, artificial stone, pottery, and like articles by the application of a coating consisting wholly or principally of urea-formaldehyde resin, and in a preferred form such a resin is employed together with one or more other resins such as phenol-formaldehyde resin. Two or three coats of the resin are applied, each coat being dried before a covering layer is added, and the coated article is heated for 3 to 5 hours. In one example, phenol-formaldehyde resin, dissolved in alcohol, and pigment such as zinc oxide, castor oil, and ammonium sulphate are added to a solution of urea-formaldehyde resin. The mixture is ground and dilute spirit added. In another example, concentrated urea-formaldehyde resin is added to wood spirit, amyl alcohol, ethylene chlorodin, titanium white, etc., and castor oil.

**Facing stone articles.** BRITISH THOMSON-HOUSTON CO., LTD. Brit. 282,810, Feb. 22, 1928. Slabs, tiles, etc. are formed of mineral composition having a coating of resin consisting of polyhydric alcohol and a polybasic acid, such as glycerol and phthalic anhydride. The body portion of the slab, etc., may include asbestos in its composition. The body may also consist of asbestos bonded with Portland cement or magnesium hydroxide, or water glass with various mineral fillers may be employed. The resin may be colored with a dye and be applied either as a powder or by dipping, painting, or spraying. The coating is converted to a hard condition by baking the coated article at a temperature of 150–200°C, and this treatment may be carried out in two stages. When the coating is in powder form the article to be coated is heated to 200°C. A priming coat of clear resin may be followed by coats of resin containing a filler or pigment. The resin may be associated with a plasticizer such as indene, diethylphthalate, glycol diacetate, benzyl alcohol, anisol, ethyl lactate, etc.

**Calcining Portland cement in rotary kilns.** Ger. 440,747; *Rock Prod.*, **31** [3], 77 (1928). The calcining zone is provided with an attachment containing channels for

conveying the material under treatment, and with axial or approximately axial conduits through which a portion of the air for combustion is drawn into flame. F.P.H.

**Production of unsintered hydraulic cement.** Ger. 440,795; *Rock Prod.*, **31** [3], 77 (1928). An intimate mixture of clay with quick, dry, or slaked lime is calcined, using oil shale as fuel, and the product is ground to cement. Burnt shale may be added to the original mixture, and limestone or lime marl at any stage of the process. F.P.H.

## Enamels

**The labor and air-power cost of sand-blasting.** EDWARD H. STEHMAN. *Jour. Amer. Ceram. Soc.*, **11** [4], 227–34 (1928).—Efficiency data are given from experience on adjustment of air and sand quantities, size and shape of nozzle, and distance of nozzle from the work. Production data are given on blasting of large ware and barrel cleaning of small ware. The data are shown in curves.

**Physical and chemical properties of oils and problems of their removal.** F.H. GUERNSEY. *Jour. Amer. Ceram. Soc.*, **11** [4], 235–40 (1928).—Tool lubrication in sheet metal working is principally a matter of rapid development of a stable but deformable film. Viscosity is of lesser importance. Structure of the film is more important than thickness. Removal problems involve neutralization, wetting, emulsification, and direct counter colloidal pull to disrupt and disperse the film completely. Free rinsing of detergents and suspensions is necessary.

**Annealing porcelain parts.** ANON. *Enamelist*, **4** [1], 8–10 (1926).—The consensus of opinion of a number of technical men prominent in the enameling industry, is that annealing an enameled piece is of no value. M.E.M.

**Dry process enameling.** A. L. VODICKA. *Enamelist*, **4** [2], 10–12 (1926).—A general description of the process. M.E.M.

**Heating porcelain enameling furnaces.** H. L. BROOKS. *Enamelist*, **4** [3], 14–20 (1926).—B. discusses the obvious advantages of electric heating. They are (1) a constant temperature uniform over the entire furnace; (2) clean furnace atmosphere; (3) lower maintenance costs; and (4) rapid heating up. M.E.M.

**Cone screen test for milled enamels.** ANON. *Enamelist*, **4** [6], 7–9 (1926).—A cone shaped frame, 5 in. high, 3 in. in diameter at the base, is covered with a screen of suitable mesh. A given amount of enamel slip, when washed through this screen, will leave a residue in the apex of the cone, the height of which will be a measure of the fineness of the enamel. M.E.M.

**Gas in enameling.** H. R. WHITTIER. *Enamelist*, **4** [6], 10–14 (1927).—The H. R. Whittier Co. uses a gas-fired, semimuffle furnace in enameling dials. With gas at $1.25, the fuel cost is considerably higher than oil, but much better quality of work is done. The enamel for these dials is ground dry, then washed to remove finely ground enamel. This fine enamel is later applied to the backs of the dials by slushing. The coarse portion, after washing, is hung in a cotton bag, and is air dry in about three weeks. It is then heated over a gas burner to remove the last traces of moisture, and applied to the copper disks by the dry process. M.E.M.

**Firing wet process cast iron enamels.** J. E. HANSEN. *Enamelist*, **5** [1], 7–9 (1927).—Enamels for cast iron should be fired at a temperature just hot enough to cause them to fire down smoothly. Castings of great difference in thickness should be withdrawn from the furnace about the time the enamel starts to fuse, and allowed to cool about a minute to equalize the temperature. This is less necessary if extremely heavy loads are fired, when the furnace comeback is slow enough to take care of this. M.E.M.

**Action of chemical cleaners.** H. D. CARTER. *Enamelist*, **5** [1], 10–12 (1927).—Alkaline cleaners, to remove oil and grease from sheet iron, must contain alkali for

saponifying the vegetable and animal oils, and emulsifying ingredients to loosen and remove the mineral oils. Their action is greatly aided by heat and agitation. M.E.M.

**Factors influencing the pickling of sheet iron for enameling.** G. S. LINDSEY. *Enamelist*, 5[1], 21–23 (1927).—Sulphuric acid is usually used at 5% to 8% strength, and a temperature of 140°–160°F. Muriatic acid can be used satisfactorily in cold solution at 10%–12% strength, but its first cost is high. An increase of 20% in temperature will compensate for a 2% decrease in strength. When the iron content of a pickling solution goes above 8%, the solution should be discarded. Sheet iron will pickle faster in Monel baskets than in wooden ones, due to an electrolytic action which is set up. M.E.M.

**Drying of wet process enamels.** H. E. EBRIGHT. *Enamelist*, 5 [1], 29–33 (1927).—Drying was originally done by blowing warm air on and around the ware, but this system tended to dry from the top down, causing cracking of the surface. Ware is now dried in heated chambers with hot air applied from below. Sketches of two types of modern driers are shown. M.E.M.

**Air agitation.** F. S. MARKERT. *Enamelist*, 5 [1], 35–37 (1927).—A sketch and description of a tank for holding wet enamel, with air agitation to keep the enamel suspended. This tank has been running 2½ months without cleaning out. M.E.M.

**Checking fuel oil consumption.** F. S. MARKERT. *Enamelist*, 5 [2], 7–9 (1927).—An old hot water tank has an outlet fitted at the bottom and connections made at the top for filling with oil, for a compressed air line, and a pressure gage. Fill the tank with a given amount of oil, wheel it to the furnace to be tested, then connect the discharge to the oil line serving the furnace, put the oil under the required air pressure and an exact consumption figure can be obtained for any oil pressure. M.E.M.

**Notes on shop troubles.** J. E. HANSEN. *Enamelist*, 5 [3], 7–12 (1927).—A general discussion of troubles occurring in enamel shops, their cause and cure. M.E.M.

**Proper pressure for sand blasting.** C. W. MEHLING. *Enamelist*, 5 [4], 7–11 (1928).—M. advocates the use of high pressure (100 lbs.) to insure a clean surface, and favors steel shot over sand. The minimum cost of sand in this shop is .0012 per lb. of cast iron, against .00075 for steel shot. In addition there is much less dust to haul away. M.E.M.

**Cast iron for enameling purposes.** Bur. Stand., *Tech. News Bull.*, No. 130, p. 20 (1928).—The program of enameling different irons under various conditions, both at the Bureau and in the laboratories of 2 plants has been completed. Some interesting relationships have been found to exist in the blistering tendencies of these various sets of castings. When a surface layer of iron is removed from any of the castings studied, even those most prone to blistering, the blistering tendency disappears. Data are being obtained which should indicate whether the improvement can be attributed to bodily removal of blister-producing material in the surface layer of iron or to some other cause. R.A.H.

**Test on new enamel factory grates.** WILHELM GREINER. *Keram. Rund.*, **35**, 337–38 (1927).—The increased life of grates made of special steel as compared with those of iron is noted in a six-months test. H.I.

**Gas cuts costs in fusing enamel to metal.** WILSON A. SMITH. *Ceram. Age*, **10** [6], 201–203 (1927).—S. gives a detailed description of the cook-stove plant of the Cribben and Sexton Co., of Chicago, Illinois, which covers more than nine acres of ground. After describing the foundry and other mechanical departments, S. describes the equipment and mode of operation of the enameling division. In the firing department are three types of gas-fired enameling furnaces, the intermittent, semimuffle, and full muffle types, and two coal-burning furnaces. S. describes these in detail and then makes

a tabular comparison of their costs of operation. The data given show that ware is enameled more cheaply in the gas furnaces than in the coal-fired units. A.E.R.W.

BOOK

**Metallographic Researches.** CARL BENEDICKS. New York: McGraw-Hill Book Co., Inc. $4.00. 20*s*. Reviewed in *Trans. Faraday Soc.*, **23**, 331–32 (1927). (*C. A.*)

PATENT

**Enamels.** I. KREIDL. Brit. 283,130, Feb. 29, 1928. An opacifying agent for enamels, glazes, etc. consists of synthetically-prepared aluminium alkali silicates or aluminium alkaline earth silicates. The alkali or alkaline earth is preferably combined with the aluminium silicate in such proportions that there are two parts of $SiO_2$ to one part of metallic oxide. The alkali or alkaline earth is introduced into the compound by treating the aluminium silicate with oxide, hydroxides, carbonates, etc. of the alkalis or alkali earths, or mixtures thereof. As an example, kaolin is introduced into a boiling solution of caustic soda and the product is dried if necessary at increased temperature.

## Glass

**Beryllium for glass molds.** ANON. *Ceram. Ind.*, **10** [3], 285 (1928).—Glass manufacturers and mold workers should look into the possibility of using beryllium in their mold iron mix. It is said that an addition of as small a quantity as 2% plus the requisite heat treatment increases the hardness of the compound considerably. It is claimed that alloys using this metal are more resistant to corrosion than carbon steel. The metal suffers very little from cracking during hot and cold treatment and has the finest of wearing qualities. F.P.H.

**New era for glass container men.** ANON. *Ceram. Ind.*, **10** [3], 311–14 (1928).—A report of the meeting of the Glass Containers Association held at Washington, D. C. during the week of Feb. 1, 1928. F.P.H.

**Porosity and density of refractory materials in the glass industry.** ANON. *Ceramique et Verrerie*, 493–95 (1926); *Tonind. Ztg.*, **51** [96], 1752 (1927). F.P.H.

**Opal glass.** J. F. HYSLOP. *Jour. Soc. Glass Tech.*, **11** [44], 362–74 (1927).—H. explains exceptions to the generalization of Gehlhoff and Thomas relative to the cause of brittleness in opal glasses. Opal melts were quenched from high temperatures to prevent separation of opalizing materials, then heated at temperatures ranging from 700–1200°C, and allowed to cool slowly. Separated particles showed increase in size with increasing temperature from less than .17 micron diameter at 700°C to 3.7 micron at 1000°C. Above 1000°C particles are smaller and not spherical but crystalline. The particle size for temperatures under the critical point is inversely proportional to the viscosity of the glass. H. finds that the brittleness of an opal glass is not directly determined by the working temperature but by the tendency of the glass to produce angular devitrification crystals; such crystals render the glass brittle to the extent, size, and uniformity of distribution in which they are present. Brittleness in opal glass is due to working the glass in the devitrification range of the matrix glass or by using a glass of too high fluidity which permits the growth of angular fluoride crystals. The size of the cullet may influence the brittleness of the glass by influencing its homogeneity. D.J.McS.

**Birmingham glass trade, 1740–1833.** F. BUCKLEY. *Jour. Soc. Glass. Tech.*, **11** [44], 374–86 (1927).—A history of the manufacture of glass in and about Birmingham during the last half of the 18th and the first half of the 19th Centuries. Production consisted mostly of cut glass and specialties. D.J.McS.

**Detection of selenium in decolorized bottle glasses.** E. J. BOWMAKER AND J. D. CAUWOOD. *Jour. Soc. Glass Tech.*, **11** [44], 386–93 (1927).—B. and C. test the application of Schmidt's test for selenium using codeine salts and sulphuric acid to the detection of the minute quantities of selenium in glass decolorized by this element. They were able to detect with certainty amounts as small as .00001 g. They find that the most important factor in the successful operation of the test is the amount of codeine salt used. The test is conducted as follows: About 1 g. finely powdered glass is decomposed with hydrofluoric and nitric acids. The hydrofluoric is completely decomposed and the nitric partly volatilized. Ten cc. concentrated sulphuric acid is then added, the mixture is fumed and then cooled. A small piece of codeine sulphate no larger than a pin head (about .5 mg. in weight) is dissolved in the cold acid and the mixture then heated to the fuming point. The presence of selenium is indicated by the development of an emerald green color. Manganese gives a similar color of much lower intensity and, if present, should be removed before solution of the material in the concentrated sulphuric acid. None of the other common constituents of glass interfere with the test. D.J.McS.

**Homogeneity of glass melted in pots on the commercial scale.** G. A. GREEN AND W. E. S. TURNER. *Jour. Soc. Glass Tech.*, **11** [44], 407–15 (1927).—Analyses of a number of commercial glasses taken from different depths in pots indicates that under ordinary commercial conditions pot glasses made without the application of mechanical stirring are very uniform in composition even when of moderately high lead content. On standing in the pot, the tendency is for the alumina and iron contents of the glass to increase gradually. Glass taken outside the ring is usually richer in silica and alumina and lower in lead than that from within the ring. D.J.McS.

**Properties of soda-baryta-silica glasses and a comparison with corresponding soda-lime and soda-lead oxide-silica glasses.** S. ENGLISH AND W. E. S. TURNER. *Jour. Soc. Glass Tech.*, **11** [44], 425–32 (1927).—Literature on glasses containing barium is reviewed. The effect of barium substitution for soda in increasing the density is intermediate between that of lime and that of lead, lying much nearer the latter. Substitution of soda by baryta causes a slight increase in annealing temperature (in distinction from the action of lead oxide) but very much less than the increase caused by the substitution of soda by lime. Of the three types of glass, the barium glasses have the greatest thermal expansion over the range studied and the lead glasses the least. The thermal expansion curves for the lead and lime glasses are strikingly parallel. D.J.McS.

**New work in the field of optical glass.** O. *Diamant*, **49** [9], 163–64 (1927).—A review of the literature on optical glass of recent date. This includes abstracts of works of P. Nicolardot on the different nomenclature systems of optical glasses, Zschimmer's and Zschokke's classifications of glasses according to their chemical compositions, Herman Heinrichs' classification according to the percentage of soluble oxides, and work by Peddle and by Eckert. E.J.V.

**Window glass vs. disease.** E. ZIMPELMANN. *Diamant*, **49** [14], 264 (1927).—A defense against statements that window glass is a means of furthering disease because it does not transmit ultra-violet rays. The glasses which are ultra-violet ray transmitting are discussed. E.J.V.

**On the stability of silvered mirrors.** MAX ERMES. *Diamant*, **49** [14], 264–65 (1927). —A discussion of the silvering method invented by Liebig, and the life of such coatings on mirrors. E.J.V.

**Glass mirrors and glass metallization.** O. *Diamant*, **49** [14], 307–308 (1927). —A discussion of the different types of mirrors, beginning with metal mirrors used by the Romans, bronze mirrors, obsidian mirrors, and finally glass mirrors, coated with

mercury amalgam. The silvering of glass is described. Gold and platinum mirrors are also mentioned. E.J.V.

**Artificial eyes.** ANON. *Diamant*, **49** [14], 365–66 (1927).—A historical sketch of the artificial eye industry started in 1597 by Müller and Greiner in the Thuringian Forest, and the development thereof to the present day. Different types of artificial eyes produced are discussed. E.J.V.

**Plate glass polishing machines. II.** F. W. PRESTON. *Glass Ind.*, **9** [3], 57–59 (1928).—Where formerly considerable time was spent in polishing glass, the present day methods require very little time in comparison, but the total power consumption in both cases is practically the same due to the use of more power for a shorter time instead of a little power for a long time. The laws of polishing are thoroughly discussed and the effects of various styles and shapes of polishers, together with different sorts of motions given the polishers are explained, with the aid of diagrams. For part I see *Ceram. Abs.*, **7** [4], 220 (1928). E.J.V.

**Large disk of optical glass completed.** Bur. Stand., *Tech. News Bull.*, No. 130, pp. 15–16 (1928).—For abstract see *Ceram. Abs.*, **7** [4], 222 (1928). R.A.H.

**Ultra-violet transmission of glasses and glass substitutes.** Bur. Stand., *Tech. News Bull.*, No. 130, pp. 16–17 (1928).—A reprint of Bur. of Stand., *Letter Circ.*, No. 235, on this subject is given. Since ordinary window glass shuts out the ultra-violet rays below 310 millimicrons in length much attention has been given to the production of glasses transparent to the shortest wave lengths which the atmosphere permits the sun to furnish us. The Bureau has tested and has given results on the total transmission of various glasses, when new, for the ultra-violet solar rays. Remarks on transmission of rays and deterioration of glasses of various trade names are given. R.A.H.

**The melting processes of the soda-lime glasses.** HUGO HERMAN. *Sprechsaal*, **61** [1], 6–9; [2], 24–27 (1928).—Examination of the minutest sections that a glass of a given composition can yield shows that the size and synthesis of the grains depend on the raw-batch materials. If one takes the sand as given then one can derive from it the maximum grain size of the other raw materials. An examination of a dipped sample of soda-lime glasses will show probable inhomogeneity to remain due to foamy structure especially when mechanical stirring is limited. At the beginning of the melt the solution tension of the quartz plays a greater rôle than the diffusion of the bases. No general theory can be advanced for the course of the melting processes of different glasses. R.A.H.

**Glass industry in Thuringia.** ANON. *Amer. Glass Rev.*, **47** [13], 14 (1928).—Financial conditions of industry are reported improved. Exports and duties are discussed. P.F.C.

**Making battery jars and carboys.** S. B. ROBERTS. *Amer. Glass Rev.*, **47** [13], 15–17 (1928).—The early history of glass at Gaynor glass works in Salem is discussed. The sources of power, processes of manufacture, and yearly output are discussed. P.F.C.

**New obscure glass developed by experiments offered as "Magnalite."** ANON. *Amer. Glass Rev.*, **47** [15], 28 (1928).—This glass is made in plain and wired sheets, possesses cross-ribbing, which gives a two-way reinforcement, resulting in abnormal strength and rigidity. It is a clear glass with both surfaces smooth. Deep pockets being eliminated, it is easily cleaned. The glass is absolutely obscure, well annealed, uniform in quality, cuts easily, and nominal in cost. It is introduced by J. Merrill Richards and manufactured by the Mississippi Glass Co. P.F.C.

**Increased use of glass containers.** ANON. *Amer. Glass Rev.*, **47** [17], 17 (1928). —On a survey of the advertizing sections of certain magazines, it was noted that

strides are being made by the Glass Container Association in its efforts to increase the use of glass bottles, jars, and containers, etc. The various uses of glass and fields for further expansion are discussed. P.F.C.

**A radio address on the glass container industry.** I. E. JENNINGS. *Amer. Glass Rev.*, **47** [18], 15 (1928).—Through WNRY, the Roosevelt Hotel Broadcasting Studio, New York City, an interesting address on the glass container industry was delivered by J. The history of glass was discussed. Until recent years the methods of manufacture differed little from those employed by the ancients. The revolution of the industry came in 1900, when Michael J. Owens and Edward D. Libbey joined their efforts in the manufacture of the ideal container which resulted in the availability of the glass containers at a cost and in a perfection not before thought possible. The many uses of the glass containers for chemicals, packing foods, etc. are discussed. The evolution of the industry in reference to child labor is also brought out. The slogan adopted by the glass container industry is "See What You Buy—Buy in Glass." P.F.C.

**Weighing equipment in glass plants.** J. E. WOODLAND. *Amer. Glass Rev.*, **47** [20], 15–16 (1928).—Weighing appliances used in glass manufacture and the specific application of scales to the varied processes are discussed. P.F.C.

**Record run reported.** ANON. *Amer. Glass Rev.*, **47** [21], 13 (1928).—What is believed to be a record run for speed and quality of production is reported at the Wichita Falls Window Glass Co., Wichita Falls, Texas. The six cylinder machines in operation at this plant are said to be averaging 100 boxes per eight hours, while one operator recently obtained 107 boxes of glass from his machine in the eight-hour blowing. P.F.C.

**Gas producer operation at glass plants.** VICTOR WINDETT. *Amer. Glass Rev.*, **47** [22], 17–19 (1928).—This includes a description of the workings of gas producers supplying raw gas to glass tanks and the results obtained. Furnace conditions in the glass industry regarding the heat supply, permit but the smallest variations from the standards required for satisfactory glass making. The following specifications control the choice of equipment: (1) a good grade of low sulphur bituminous coal should be selected; (2) a regular temperature of gas on leaving producer must be maintained; (3) a uniform quality of gas must be maintained; (4) a gas low in hydrogen and high in carbon monoxide is desired as giving the most satisfactory conditions in the furnace; (5) an even and low gas pressure should be the normal condition at the producer offtake; (6) as low a moisture content of the gas as possible is desired. Data concerning installation of ten furnaces, analyses of coal and gas, and problems arising in the operation are related. A discussion of summarized results is given. P.F.C.

**Ultra-violet ray glass.** ANON. *Nat. Glass Budget*, **43** [37], 24 (1928).—Some of the tests to which this glass was subjected before being placed on the market are discussed. Some of the points considered are: (1) the percentage of ultra-violet rays which the glass will transmit below 3200 A.U., (2) the effect of moisture upon the surface of the glass, and (3) the loss in efficiency due to exposure to the sun. When new this glass is found to transmit over 60% of the ultra-violet rays in the so-called vital range, that is between 2910 and 3200 A.U. It also depreciates less in efficiency than any other glass used for therapeutic purposes. Rain or snow have no effect upon it, and constant washing and exposure will not cause the glass to deteriorate or change in color. P.F.C.

**Manufacture of "Duplate."** ANON. *Nat. Glass Budget*, **43** [40], 3 (1928).—The Pittsburgh Safety Glass Co. has been incorporated with a capitalization of one million dollars and will produce the so-called "laminated" or "nonshatterable" glass, which will be marketed under the trade name of "duplate." The product is composed of polished plate glass and pyroxylin plastics. A super quality pyroxylin plastic, produced by the

DuPont Viscoloid Co., makes this product possible without the objectionable features of the previous glasses of this type. The Pittsburgh Plate Glass Co. will manufacture the glass, which will be of high quality, thin, and of highly polished plate glass. It eliminates danger from flying glass in case of accidental breakage. P.F.C.

**Use for broken glass.** ANON. *Nat. Glass Budget*, **43** [40], 20 (1928).—A press dispatch from Hongkong says that 4000 T. of broken glass are gathered in the vicinity of that town each year and sold to some one or more of the 20 glass plants in operation there. The old bottles and glassware are used by the firms in the manufacture of bottles, lamp chimneys, flint glass, and beads. It is said that three-quarters of the glass imported into China comes from the U.S. P.F.C.

**The Amco portable leer.** ANON. *Nat. Glass Budget*, **43** [44], 3 (1928).—It is used for the annealing of hollow and pressed ware and is the most advanced embodiment of the essential features of control, economy, capacity, and mobility. Fuel consumption is not a serious factor in this machine; control is positive, exact, and mechanically balanced by induction; production by increase in capacity over old heavy chain type and pan type has been more than doubled; it is movable and hence subject to changes in future. The fuel, annealing temperature control, economy of annealing temperature control, cooling method, general economy, capacity, mobility, general mechanical and physical components, adaptability, durability, and muffles are discussed. P.F.C.

**Hypressure jenny, the movable cleaning outfit.** ANON. *Nat. Glass Budget*, **43** [44], 18 (1928).—A new type of mold (or other equipment) cleaning machine is made by Homestead Valve Mfg. Co. It is made up in stationary and portable units, both types operating by plugging in at the nearest socket. The cleaning solution and fuel are delivered from the end of the nozzle at 100–130 pounds pressure in the form of water vapor laden with cleaning solution. This unit is especially adaptable to cleaning molds and molding machinery in glass plants, since it furnishes heat, pressure, and cleaning solution combined, thereby cleaning grease and dirt from surfaces no matter how intricate. It is readily operated by unskilled labor. In addition it may be used for cleaning floors, walls, and windows. P.F.C.

**The annealing of glass, a nontechnical presentation.** A. N. FINN. *Glass*, **3** [10], 411–17 (1926); reprinted from *Jour. Amer. Ceram. Soc.*, **9** [8], 493–500 (1926); for abstract see *Ceram. Abs.*, **5** [10], 300 (1926). A.J.M.

**Bristol and Nailsea glassware.** EDITH H. WALTON. *Int. Stud.*, **89** [369], 47–51 (1928).—An article interesting to collectors describes Bristol and Nailsea wares and gives information as to their history and development. E.B.H.

**Germany's foreign trade in glass and glassware in 1926.** KURT LUDWIG. *Keram. Rund.*, **35**, 106–10 (1927). H.I.

**Silvering of glass plates for optical instruments.** MANLEY. *Phil. Mag.*, **4** [7], 1322–23 (1927).—Silvering of glass mirrors by ordinary processes gives a coating which does not adhere sufficiently to stand necessary polishing. Two methods are given for overcoming this difficulty. The glass plate and the solution are thoroughly cooled in ice water and the solution poured over the glass plate and allowed to deposit for 8 or 10 hours. In the second method the deposition takes place at room temperature for 10 to 15 minutes, then a stream of water is passed through the bath for sometime gradually washing the plate. This is followed by rinsing in distilled water and drying rapidly. J.T.L., JR.

**Electrolytic decomposition of glass.** P. SELÉNYI. *Ann. Physik*, **84**, 111–18 (1927).—A vacuum incandescent lamp serves to demonstrate the electrolytic decomposition of glass. The bulb is immersed in a $KNO_3$ bath or wrapped with Sn-foil which serves as one electrode, while the ionized residual gas is the other electrode. The glass bulb decomposes, yielding Na, $SiO_2$, and $O_2$, probably according to the equation $Na_2SiO_3 \rightarrow$

$2Na^{+}+SiO_2+O^{--}$. A Na "mirror" forms on the cool parts inside the bulb when the bath or foil is connected with the positive pole of the lamp. When the outer electrode is connected with the negative pole of the lamp, a layer of poorly conducting $SiO_2$ forms on the inner surface of the bulb, and $O_2$ is liberated inside the bulb. The latter is evidenced by the appearance of the characteristic glow of gas-filled lamps, and if a W-filament is used, the blue oxide of W is formed. (*C.A.*)

PATENTS

**Flow feed for glass machines.** SAMUEL E. WINDER AND HENRY C. DAUBENSPECK. U. S. 1,648,435, Nov. 8, 1927. In glass forming mechanism, a mold, means for delivering molten glass into it, means for protecting the glass from heat loss as it flows from the delivering means into the mold, the protecting means comprising a collar adapted to encircle the flowing glass, and means for raising and lowering the collar.

**Apparatus for producing a silver coating on glass.** LUITPOLD OFFENBACHER. U. S. 1,648,504, Nov. 8, 1927. An apparatus for silver coating sheets or plates of glass comprising in combination an oval track, a heated drying chamber in the shape of a tunnel on the track, a transportable frame, wheels and a table on the frame, means for producing a see-saw motion of the table, and means for propelling the transportable frame so that it runs on the track.

**Combination of glass and metal bodies.** ROBERT FRANZ MAYER. U. S. 1,649,907, Nov. 22, 1927. In glass bodies with melted-in metal piece, the combination of a tubular glass body and a cup-shaped metal closure piece having its open end melted into and closing the cavity of the glass body and with its inner end terminating within the glass body, the metal piece comprising a body part with a coefficient of expansion approximately near that of the glass, and a coating of a material to which the glass adheres well, on the body part extending over the surfaces engaged by the glass body and across the interior of the closure whereby external air, or air trapped between the coating and the body part of the metal closure piece, cannot enter the cavity in the glass body through the line of division between the coating and the body part of the closure piece.

**Glass-severing method and apparatus therefor.** CARL A. BROWN AND ANDREAS C. NIELSEN. U. S. 1,659,590, Feb. 21, 1928. The method of severing a hollow glass article from a tubular glass body to which it is attached which consists in directing a sufficiently hot and sharp flame against the same at the desired plane of separation to cause a fusion and severance while preserving substantially intact the passage through the hollow glass article and subsequently playing a flame on the severed edge of the article while it is moved from the tubular body.

**Furnace for annealing and flattening glass.** JOSEPH J. GESSNER. U. S. 1,660,157, Feb. 21, 1928. (1) A flattening oven for window glass comprising a main flattening chamber, an annealing tunnel, a settling chamber forming a connection between the flattening chamber and the receiving end of the tunnel, and in unobstructed communication therewith whereby a flattening temperature will be maintained therein from the heat in the flattening chamber, and means for receiving and forwarding successive sheets of glass from the main chamber through the settling chamber and into and through the tunnel. (2) A flattening oven comprising a main flattening chamber, a settling chamber freely open to the heat of the main chamber whereby a flattening heat will be maintained in the settling chamber by the heat in the flattening chamber, an annealing tunnel communicating with the settling chamber at a point remote from the main chamber, and means extending from the main chamber through the settling chamber and tunnel upon which successive sheets of glass may be received in the main chamber and forwarded first into and through the settling chamber and thence into and through the tunnel.

**Glass-snapping machine.** CHRISTOPHER BROWN. U. S. 1,660,323, Feb. 28, 1928. In combination in a machine for snapping transversely scored glass strips, a guideway for receiving a glass strip to be snapped into sections, a snapping edge adjacent the end of the guideway, a stop for engaging the end of strip positioned in advance of the snapping edge a distance such that one of the transverse score lines on the strip comes over the snapping edge when the strip end engages the stop, a hammer for striking the section of the strip lying in advance of the snapping edge, and automatic means for causing the hammer to strike at time intervals and for causing a step-by-step forward feed of the strip.

**Apparatus for surfacing sheets.** JOHN H. FOX. U. S. 1,660,330, Feb. 28, 1928. A surfacing train comprising a plurality of cars arranged in series end to end, overlapping members at the ends of the cars for preventing relative vertical movement thereof whereby the top surfaces are maintained flush with each other, and means carried by the cars for pulling their opposing ends into contact and holding them there with overlapping members in operative engagement.

**Machine for rounding the edges of sheets of material.** WILLIAM OWEN. U. S. 1,660,350, Feb. 28, 1928. In a machine for cutting the edges of glass sheets, a series of driven abrading wheels having their cutting surfaces arranged in alignment and adapted to cut the edges of the sheets carried thereover, means for moving the sheets over the cutting surfaces of the wheels in vertical position with an edge in contact therewith comprising driven endless carrier means along the series of wheels, and yielding clamping means arranged to grip the sides of the sheets back from the edges to be cut and to hold such edges in contact with the abrading wheels, and steady means for holding the sheets against lateral movement located intermediate the clamping means and the wheels.

**Glass-feeding apparatus.** ALBERT N. CRAMER. U. S. 1,660,415, Feb. 28, 1928. Glass feeding mechanism comprising, in combination, a container for molten glass having an outlet opening in the bottom thereof, a regulating plunger projecting into the glass over the opening, a horizontally disposed lever, operating connections between the lever and plunger, automatic means to periodically reciprocate the lever and thereby actuate the plunger, a stationary rack, a rack on the lever, a pinion in mesh with the racks and forming a fulcrum for the lever, a manual device operable to rotate the pinion and thereby shift the fulcrum of the lever while the feeder is operating, and manual means for adjusting the plunger up or down relatively to the lever during the operation of the feeder.

**Glass feeder.** LEONARD D. SOUBIER. U. S. 1,660,429, Feb. 28, 1928. Glass feeding apparatus comprising in combination a container for molten glass having a discharge outlet, a rotatable regulator extending into the glass at one side of the outlet with its axis parallel with the axis of the outlet, and means to rotate the regulator and periodically move portions over the outlet to effect periodic control of the issue of glass through the outlet.

**Glass-feeding apparatus.** LEONARD D. SOUBIER. U. S. 1,660,430, Feb. 28, 1928. The combination of a container for molten glass, means to rotate it unidirectionally, and having an outlet opening at the bottom thereof at one side of its axis of rotation, and mechanical means extending into the glass and operating therein to periodically exert an expelling force on the glass at the outlet and thereby exude charges of glass through the opening.

**Glass-melting tank.** KARL G. KUTCHKA AND THOMAS H. SWARTZLANDER. U. S. 1,661,836, March 6, 1928. In combination in a melting tank, a melting end provided with heating means, a working end having a withdrawing opening, and an arched bridge wall lying below the surface of the glass intermediate the melting end and the working end.

**Apparatus for the continuous grinding and polishing of glass in the form of strips or plates.** ROBERT FRANCIS TAYLOR. U. S. 1,661,914, March 6, 1928. In continuous grinding and polishing apparatus of the type referred to, a series of tables one end surface of each of which abuts against the adjacent end surface of the next adjacent table, a ridge on one such abutting end surface, a recess in the other of the abutting end surfaces, the ridge and recess being in mutual engagement to prevent relative motion between the end surfaces in either direction perpendicular to the plane of the supporting surface of the tables, and means for retaining the end surfaces in abutment.

**Method of and apparatus for producing molten glass.** CHARLES B. KINGSLEY. U. S. 1,662,116, March 13, 1928. The method of operating a glass melting apparatus comprising confining molten glass within tank walls, laying a new course of block under a wall section, and raising the new and old portions of the section to displace the top course of the old section in the side wall.

**Apparatus for and method of feeding molten glass.** KARL E. PEILER. U. S. 1,662,436, March 13, 1928. The combination of a molten glass container having a submerged outlet, means to periodically apply pneumatic pressure on the surface of the glass to exert an extruding force thereon, means to periodically reduce the pressure on the surface of the glass to a point below atmospheric pressure to exert an intruding force on the glass at the outlet, means for periodically exposing the surface of the glass to atmospheric pressure for a definite period of time whereby glass is extruded by the action of gravity alone, and means operating in timed relation with the pressure applying means to periodically sever the glass adjacent to the outlet.

**Apparatus for feeding molten glass.** KARL E. PEILER. U. S. 1,662,437, March 13, 1928. The combination with apparatus for separating molten glass into mold charges, of a glass container having a submerged outlet, a pump for supplying abnormal air pressure to the surface of the glass to control its movement in the outlet, and means independent of the pump for variably regulating the air pressure.

**Compound glass.** O. Y. IMRAY. Brit. 279,671, Dec. 21, 1927. Two sheets of glass are cemented to a sheet of celluloid, cellulose acetate, or the like to make a splinterless transparent sheet for wind shields, port windows, eyeglasses, etc. by means of a film of a nonsolvent, such as castor oil or linseed oil, applied to the celluloid. The glass sheets when applied to the celluloid are subjected to a pressure of 100 lbs.–400 lbs. per square inch and a temperature of 228–240°F for 5 to 20 minutes. The pressure is applied first at the center so that excess of oil is expelled. The glass is preferably first coated with a thin film of celluloid applied in solution and thoroughly dried. The oil may be chemically pure or substantially free from other ingredients.

**Glass manufacture.** GENERAL ELECTRIC CO., LTD. Brit. 282,057, Feb. 8, 1928. Relates to a machine for making electric lamp bulbs, particularly those for miniature lamps, from glass tubing, short lengths or even scrap pieces of tubing being used. The tubes are carried by a rotatable head and their ends, after being heated, are pinched together and closed by a tool. The closed ends are then rounded and finally are blown to shape in a mold.

**Ceramic materials.** F. SINGER. Brit. 282,404, Feb. 15, 1928. A process for preventing the aging of ceramic materials, *i.e.* for minimizing the formation of vitreous amorphous constituents, consists in adding compounds of such metals and metalloids as cerium, zirconium, chromium, manganese, phosphorous, tungsten and vanadium to the main ingredients comprising silicates of alumina or magnesia and double compounds of these fundamental constituents such as kaolin quartz and feldspar, clay steatite and aluminium hydroxide, kaolin and magnesite, etc. The compounds may be oxides, carbonates, silicates, or aluminates. The added compounds cause an increase in the number of crystal nuclei in the crystallites occurring in the ceramic material.

**Glass manufacture.** Y. BRANCART. Brit. 282,637, Feb. 15, 1928. Relates to the manufacture of plate glass consisting of two or more layers, usually of different colors, which are superimposed and welded together to form a plate of uniform thickness. The invention consists in rolling on to a plate of glass, as it is formed by rolling on a casting table, a second layer of glass in a more fluid state, of the same or a different color, so that the second layer is welded to the first without mixing with it. In another method, two trains of rollers are placed at a distance from one another above a movable table, so that the ribbon of glass produced by the first train of rollers passes in a plastic state under the second train of rollers which lays on to it a second ribbon of glass, and the two layers weld together.

**Glass manufacture.** Y. BRANCART. Brit. 282,638, Feb. 15, 1928. A process for cooling equally the two sides of a sheet or plate of glass, after it has been formed, consists in introducing between the glass and its support a cushion of gas to insulate the underside of the glass from the support. The layer of gas prevents the underside of the plate from cooling more rapidly than the upper side and thus prevents the uneven contraction of the plate which causes it to buckle.

**Glass manufacture.** NAAMLOOZE VENNOOTSCHAP MAATSCHAPPIJ TOT BEHEER EN EXPLOIT VAN OCTROOIEN. Brit. 282,756, Feb. 22, 1928. Relates to the rollers, conveyer belts, link chains, or other form of conveyer which does not have an uninterrupted supporting surface, used for conveying glass plates from rolling or drawing apparatus to, or through, annealing or cooling apparatus. According to the invention, the surfaces of the rollers or belts are fluted, grooved, or pitted in order to reduce the area of contact between the glass and the material of the roller and thus reduce the chilling of the glass due to this contact.

**Glass manufacture.** C. TRENZEN. Brit. 282,768, Feb. 22, 1928. A glass which resists attack by boiling water, and is particularly intended for making laboratory ware.

**Polishing glass.** C. HEUZE. Brit. 282,862, Feb. 22, 1928. In apparatus for the continuous polishing of glass strip, plates, or sheets, of the type in which both the glass and the polishing runners travel, the felts of the runners are cleaned by lifting each runner on to a conveyer at the end of its operative travel, cleaning the felt of the runner while it is traveling on the conveyer back to its starting point, and then transferring the runner to the polishing tables for a fresh cycle of operations.

**Production of glass resistant to cracking.** F. EISSENLÖFFEL. Ger. 444,749, Aug. 29, 1924. Glass suitable for the manufacture of artificial gems contains 5–20% BeO, at least 10% $Al_2O_3$, not more than 10% of alkalis, and at least 33% $SiO_2$.

(*B.C.A.*)

## Heavy Clay Products

**Use of manganese in the manufacture of face brick.** GILBERT E. SEIL AND H. A. HEILIGMAN. *Jour. Amer. Ceram. Soc.*, **11** [4], 241–48 (1928).—The effects on color of variation in size of manganese particles, composition of the manganese, and of the character of gaseous conditions of firing are discussed.

**The effect of incorrect die adjustment upon drier and kiln losses.** LESLIE R. ALT. *Jour. Amer. Ceram. Soc.*, **11** [4], 257–61 (1928).—Experiments made to determine the relation of incorrect die regulation to drier and kiln losses which might be attributed to the die, and a method whereby the operator might check the die performance and so regulate the die as to reduce to a minimum the loses due solely to incorrect die adjustment are described and the results discussed.

**The design of hollow tile dies.** A. F. GREAVES-WALKER. *Jour. Amer. Ceram. Soc.*, **11** [4], 254–59 (1928).—The die problem is stated in terms of plant experience. Questions of piston vs. auger pressure, dimensional relations, speeds, uniformity of feed,

die shape, position and dimension of bridges, posts, and cores are discussed in relation to varying clay characteristics.

**Standard sizes for brick.** NATHANIEL LLOYD. *Brit. Clayworker*, **36** [430], 325–27 (1928).—The "R.I.B.A. Standard Sizes of Bricks," was drawn up in 1904 and represents the views of the associations concerned at that time, but does not represent present practice. It defines "for all classes of walling brick, both machine- and hand-made," the dimensions of bricks to $^1/_8$ in. and even to $^1/_{16}$ in., the thickness of joints to $^1/_{16}$ in., and illustrates these by scale diagrams. In short, dimensions intended to secure some regularity in brick sizes have actually set up a standard for brick work which acceptable in 1904 is now obsolete and harmful to the cause of good building. In view of this the R.I.B.A. has asked the Science Committee to draw up references and agenda for a conference to modify the old standards. Comparison is made of work done by bricklayers in England, U. S., and Holland with discussion on the effect on labor of various sizes of brick used in these countries. Changes which have occurred in bricks since 1904 are given. R.A.H.

**Testing of road paving brick.** G. R. L. CHANCE. *Brit. Clayworker*, **36** [430], 331–34 (1928).—The primary object of this paper is to describe the testing of road paving brick, how the different kinds of brick were made and the difficulties encountered in obtaining consistent results. There are only 2 ways of testing paving brick: (1) by actual wear and tear, and (2) by laboratory tests for abrasion, porosity, physical strength, etc. Due to the long life of the average brick pavement the former method is out of the question. Testing methods and construction of brick pavements in America are discussed. Results are given for a large number of experimental tests by the Rattler method on paving brick with the view of improving the brick. R.A.H.

**The chemical industries and bricks.** ANON. *Brit. Clayworker*, **36** [430], 338 (1928). —A high refractoriness in bricks for this industry is seldom needed in chemical works, but resistance to highly corrosive vapors, dust, and slags, is often of great importance and necessitates the use of bricks with a dense surface and a very fine uniform texture, as well as sufficient refractoriness and freedom from spalling. Grog bricks are usually better than those made from a straight fire clay, and while silica bricks are excellent for certain purposes, they are seldom so satisfactory in chemical works as those made of fire clay. Bricks made of bauxite and fire clay in proportions which will give $2^1/_2$ parts of alumina to 1 part of silica and fired to cone 14 or higher are meeting with considerable success for this purpose. Under-fired bricks are useless as the free alumina is readily attacked by acid fumes and the bricks are quickly eroded. R.A.H.

**Fire resistance of brick walls. Bricks made of clay or shale.** Bur. Stand., *Letter Circ.*, No. 228.—There has recently been completed at the Bureau of Standards a series of fire tests of brick walls to determine the fire protection, strength, and stability under fire conditions afforded by this construction. In this circular are described the materials and test specimens used, method of testing, stability and load-carrying ability, fire effects on brick and masonry, fire resistance classification, and a table giving the ultimate fire resistance periods of brick walls from the 4-in. thickness to 12-in. thickness. R.A.H.

**Fire resistance of brick walls. Walls made of concrete or sand-lime brick.** Bur. Stand., *Letter Circ.*, No. 229.—There has recently been completed at the Bureau of Standards a series of fire tests of concrete and sand-lime bricks to determine the fire-protection, strength, and stability under fire conditions afforded by this construction. In this circular are described the materials and test specimens used, method of testing, stability, and load-carrying ability, fire-effects on brick masonry, fire resistance classifications and a table giving the ultimate fire resistance periods of brick walls (sand-lime brick) and concrete. R.A.H.

**Fire resistance of brick walls.** Bur. Stand., *Tech. News Bull.*, No. 124, pp. 1–3. Typical wall constructions were subjected to fire tests under a load of 80 lbs/in.$^2$ for 4-in. walls and 160 lbs/in.$^2$ for walls of greater thickness. An accompanying table gives the ultimate fire-resistance periods developed in these tests by clay or shale brick walls. The fire-resistance period ranged from 1 hour in the case of the 4-in. wall to 10 hours with the 12-in. wall. R.A.H.

**Tentative specifications for building brick (clay or shale.)** *Proc. A.S.T.M.*, **27** [1], 803–804 (1927).—These specifications cover building brick made from clay or shale and properly fired, suitable for use in the construction of buildings. Bricks are classified into three grades according to compressive strength and modulus of rupture. Two samples of 10 brick each shall be tested for every 100,000 bricks in the lot under consideration. Permissible variation in size is given for common, rough-face, and smooth-face brick. Requirements as to inspection and rejection are listed. R.A.H.

**Tentative specifications for paving brick.** *Proc. A.S.T.M.*, **27** [1], 805–809 (1927).—These specifications cover all styles of vitrified paving brick used in pavements. They shall be manufactured from fire clay or shale or a combination of them. The bricks are subjected to the Rattler test and given a visual inspection. Ten brick shall comprise a sample and the buyer shall select same. Size and permissible variation are noted for the two classes of brick. R.A.H.

**Tentative methods of testing brick.** *Proc. A.S.T.M.*, **27** [1], 826–35 (1927).—These methods cover the following tests for brick (other than fire brick): compression test, flexure or cross-bending test, Rattler test. A description of the requirements of these tests is given. R.A.H.

**Manufacture of flue linings.** BERNHARD EULER. *Tonind. Ztg.*, **51** [82], 1491–92; [83], 1511–12 (1927).—The importance of the physical properties of the raw material used in the manufacture of flue linings is stressed. Methods of mixing the clay and of working the bodies in the green state are described. The use of various kilns for firing the product is discussed. The firing temperature is given as cone 6–7. F.P.H.

**Lamination in brick.** ANON. *Tonind. Ztg.*, **51** [83], 1510–11 (1927).—The following suggestions are given for the prevention of lamination: (1) lengthen the auger chamber to 400 mm. or longer, (2) replace the auger with one of flatter pitch, (3) diminish the plasticity of the material as much as possible, (4) soften the material to the extreme working limit, (5) winter the raw material (keep the material through the winter), (6) carefully dry the material, protect it from a draft. F.P.H.

**Drying problems discussed at annual meeting.** ANON. *Brick Clay Rec.*, **72** [4], 259 (1928).—A report of the 42nd annual meeting of the National Brick Manufacturers' Assn. held in conjunction with that of the AMERICAN CERAMIC SOCIETY. The work of the drier committee was reported and several new investigations were suggested. E.J.V.

**Possibilities for hollow tile.** EDWARD C. KERTH. *Brick Clay Rec.*, **72** [4], 260–65 (1928).—Hollow tile is being penalized in building codes and in insurance rates. It must, in many instances, compete on an unfair basis with materials that are inferior It has lost important markets because of inadequate promotion. The industry is losing countless thousands of tons because its interests are not adequately protected in cities which are extending their fire limits. Millions are being lost to hollow tile because many now undeveloped markets are not pushed. All these injustices to hollow tile are decried and remedies for each of the ills are suggested under the topics: (1) hollow tile and fire limits; (2) discrimination in hollow tile markets; (3) insurance problems for hollow tile; (4) research on hollow tile; (5) hollow tile in building codes; (6) hollow tile floors a future market; and (7) extension of engineering activities. E.J.V.

**The strength of solid and hollow walls of brick.** A. H. STANG. *Ceram. Age*,

**10** [6], 198–200 (1927).—Economy with no lack of safety can be obtained when sufficient data are at hand for the use of engineers in the design of buildings and for city officials in the preparation of codes. Few tests have been made on specimens of adequate size. S. describes tests in which 4 kinds of clay brick, 3 mortar mixtures, 10 types of wall construction, and 2 grades of workmanship were included. The object of the tests is to determine what design stresses will be safe when brick walls are built under careful supervision, using strong brick and strong mortar. In this connection the relation between wall strength and brick strength, brick design, mortar strength, workmanship, wall size and moisture conditions during setting will be determined. Tests on 96 solid and hollow walls have been completed and are reported in the paper. The average strengths of the walls tested are given in tables and the results plotted in diagrams. Solid walls built from strong brick were stronger than solid walls built from weak brick, but hollow walls did not show this relation for the bricks and walls studied. Solid walls were stronger than hollow walls of similar gross area, but the hollow walls tested were several times as strong as the minimum specified by the building code committee of the Department of Commerce. A.E.R.W.

**Most modern brick plant in the world.** W. C. KEMPF. *Ceram. Age*, **11** [1], 15–17 (1928).—K. gives a description of the Sayreville (N. J.) plant of the Sayre and Fisher Company, one of the pioneer companies of this country, which has a rated capacity of one million brick a day. The manufacture of enameled brick, fire and front brick, and red brick is described, as well as the shipping facilities. Statistics concerning the number of kilns, their capacity and fuel consumption are given. A.E.R.W.

**Brick clay arch 5000 years old.** LEONARD WOOLEY. *Morning Post*, Feb. 14, 1928.—The Univ. of Pa. excavations at Ur of the Chaldees have resulted in the finding of the unrifled tomb of the Sumerian queen Shub-Ad. The tomb has doorways crowned by a true arch of brick clay. This antedates the previously known oldest arch by 2000 years. H.H.S.

BOOK

**Petrographic Investigation on the Suitability of Granite as a Paving Material.** W. ZELTER, 69 pages with tables and illustrations. Halle A. S., W. Knapp. 1927. *Amer. Mineral.*, **13** [3], 121 (1928). F.P.H.

## Refractories

**The influence of different feldspars on the "freezing" behavior of cones.** EDWARD ORTON, JR. AND J. F. KREHBIEL. *Jour. Amer. Ceram. Soc.*, **11** [4], 215–23 (1928).—The term "freezing," in ceramic parlance, means the increased resistance to viscous fusion, which ceramic bodies often show when their heat treatment is interrupted by chilling or the temperature is held static too long and not allowed to progress upward at the usual or proper rate. A body so treated often becomes distinctly more refractory and cannot be softened to viscous fusion without use of a higher temperature than would otherwise have been necessary. In this condition, it is said to be "frozen." This freezing behavior may occur in the firing of cones as in other ceramic products, and, because of the use to which they are put and their shape which facilitates accurate comparisons, is more serious in its consequences and more easily detected than in other ceramic products. The present study was undertaken (*a*) to get some definite quantitative measurements of just what this lag in fusion amounts to under a given set of conditions, (*b*) to determine whether it is a peculiarity due to some one ingredient or combination of ingredients, or whether it is a generic quality applying to all ceramic mixtures of a given range, and (*c*) to get any new light that could be had as to the ultimate nature or cause

of the phenomenon. The amount of the lag has been quantitatively determined for cone 10 as furnished by the Germans and our own factory, and the influence of different feldspars and clays in producing this lag has been experimentally studied. Different feldspars are shown to produce characteristic effects. No important light is thrown upon the ultimate cause of the phenomenon.

**Heat penetration in refractories.** M. C. Booze. Amer. Refrac. Inst., *Bull.*, No. 19, Jan. 1928.—There are many misconceptions of the manner in which heat penetrates refractory materials and its resultant effect. Advertizing matter often claims that the application of a thin wash or coating of a so-called refractory cement will prevent or reduce heat penetration and consequently result in less rapid destruction of the furnace lining. An understanding of the mechanics of heat flow will show that this is ordinarily untrue and even if the claim does hold, the effect will soon be obscured. It is also generally believed that the application of water or air cooling to the outer face of a furnace wall will reduce the temperature of the hot face by a considerable degree. The latter conception holds under some conditions of heating and with thin walls, but generally speaking, is not noticeably effective in lowering the temperature at the hot face. Furnace operators and refractories manufacturers usually hold that porous hand-made fire brick are much better heat insulators than denser brick made by other manufacturing methods. While it is certainly true that voids or pores lower the heat conductivity, the effect is dependent upon pore size, continuity, number of pores, and other factors, so that general statements are apt to be misleading. There is an advantage in using dense checker brick because of the greater heat capacity. It is theoretically possible to produce a surface on a refractory wall either by coating or otherwise, which will resist the penetration of heat and produce a noticeable drop in the mean wall temperature. This resistance, however, will depend upon surface characteristics. When the furnace is in use for some time the surface will be coated with ash or slag or altered by vitrification and the effect upon heat penetration almost, if not entirely, lost. Most of the refractory cements which are advertized for such purposes are not of any value in this way, as they are more resistant than the fire brick themselves and may be even less so. It is not to be expected that the outside cooling of thick walls will appreciably reduce slag action, since the latter is largely a surface effect. Because of the resistance of refractory materials to heat flow, and their heat capacity, time is a factor in determining heat penetration, as it is in vitrification and softening.

F.P.H.

**Determination of titanium in refractory brick.** L. Lamal. *Keramos*, **6** [12], 480 (1927); *Bull. Soc. Chim. Belg.*, **36**, 395–96 (1927). F.P.H.

**Refractory materials for the electric steel furnace.** E. Kothny. *Feuerfest*, **3** [10], 157–64 (1927).—The following subjects are discussed: (1) classification of electric furances and their hearth forms, (2) general requirements of materials of construction for electric furnaces, (3) enumeration of refractory materials suitable for electric furnaces, (4) special requirements of refractories suitable for electric furnaces. The following properties of refractories are desirable when they are to be used in electric furnaces; (1) higher softening point, under loads and without loads, (2) greater resistance against the action of slags and against oxidizing and reducing influences, (3) high resistance to heat shock, (4) low heat conductivity and specific heat, (5) low electrical conductivity. The physical and chemical properties of the following refractories which have been successfully used in various electric furnaces are summarized in table form, silica brick, quartz sand, magnesite brick, burned magnesite clay brick, chrome brick, Carborundum brick, brick of fused alumina, magnesia-spinel brick, sillimanite brick, zirconium oxide brick.

TABLE I

Physical and Chemical Properties of Some Refractories Used in Electric Furnaces

| No. | Refractory | Composition | Fusion pt. °C | Softening pt. under load °C | Sp. gr. | Porosity coef. % vol. | Conductivity g. cal/ccm/°C |
|---|---|---|---|---|---|---|---|
| I | Silica brick | 95% $SiO_2$ | 1720–1750 | 1620–1650 | 2.29–2.45 | 17–25 | .0026 (200°)<br>.00426 (1000°)<br>.0050 (1370°) |
| II | Magnesite brick | >85% MgO | 1980–2100 | 1500–1700 | 3.45–3.70 | 25–30 | .0065 |
| III | Clay brick | 45% $Al_2O_3$<br>50% $SiO_2$ | 1650–1720 | 1250–1350 | 2.62–2.72 | 20–25 | .0042 (1000°) |
| IV | Chromite brick | 44% $Cr_2O_3$<br>22% FeO | 2050 | 1510 | 4.3 –4.8 | 20–25 | .0034 |
| V | Carborundum brick | SiC | dec. 2220 | 1400–2000 depending on bond | 3.12–3.20 | 25–30 | .0231 (1000°) |
| VI | Alundum brick | $Al_2O_3$ | 1900–2050 | 1750 | 3.6 –4.0 | 14 | .0083 (1250°–1650°) |
| VII | Magnesia-spinel brick | $MgO \cdot Al_2O_3$ | 2135 | 1900–2100 | — | — | — |
| VIII | Sillimanite brick | $Al_2O_3 \cdot SiO_2$ | 1816 | 1700 | 3.2 | 15 | .0044 (900°) |
| IX | Zirconium oxide brick | $ZrO_2$ | 2500–2600 | 1800–1900 | — | — | Small |

TABLE I (*continued*)

| No. | Spec. heat | Linear coef. of expansion | Heat shock factor Magnesite brick = 100 | Electrical Temp °C | Resistance ohms/ccm. | Resistance of Refractories to Chemical Attack† Basic fluxes (attack) | Acid fluxes | Reducing atmospheres | Molten oxygen-free metals |
|---|---|---|---|---|---|---|---|---|---|
| I | .227 (25–600°)<br>.295 (25–1400°) | $1.21\times10^{-5}$ (14–1260°) | 75 | 1300<br>1400<br>1550 | 9700<br>2400<br>22 | Small | Only by fluorides | To 1050 scarcely attacked | Not attacked by Sn, Zn, Cd |
| II | .253 (200°)<br>.290 (600°)<br>.324 (1000°)<br>.349 (1300°) | $1.26\times10^{-5}$ (14–1200°) | 100 | 1300<br>1400<br>1550 | 6200<br>420<br>30 | None | Strong | To 1500 slightly reduced | Not attacked |
| III | .297 (14–1400°) | $.59\times10^{-5}$ | 3–30 | 1300<br>1400<br>1550 | 1300<br>690<br>60 | None | Slight | Under 1500 scarcely attacked | Above 1300° not usable |
| IV | .199 | $1.07\times10^{-5}$ (1500°) | 42 | 800*<br>1200<br>1400 | 2800<br>450<br>320–410 | By CaO at high temps. | Slight | At higher temps. reduced to ferro-chrome | Not attacked |
| V | .185 (900°) | $4.35\times10^{-6}$ (1000°) | 2 | 800<br>1200<br>1550 | 1255<br>2300<br>60 | Reacts with FeO at 1300°, MnO at 1360°, MgO at 1000° | Reacts with SiO at 1200° | | |
| VI | .198 | $.71\times10^{-5}$ (900°) | 13 | 535<br>721<br>1040 | 47,600,000<br>4,900,000<br>750,000 | By strong basic slags and steam | Strong | | Not attacked |
| VII | .19 (15–470°) | — | good | — | — | None | Slight | Reduced | " |
| VIII | .168 | $.48\times10^{-5}$ | good | — | — | Very little | None | Reduced | " |
| IX | .175 (25–1400°) | $.84\times10^{-6}$ | good | — | — | None | By molten fluorides | Forms carbide at high temps. | " |

* Carborundum B with clay bond.

† None were attacked by oxidizing atmospheres

F.P.H.

**Progress in refractories in England.** W. STEGER. *Feuerfest*, **3** [11], 173–81; [12], 189–94 (1927).—S. gives a review of the English literature on refractories for the years 1925 and 1926. The numerous references given furnish an excellent bibliography on refractories. F.P.H.

**Influence of sodium carbonate on refractory linings.** G. S. EVANS. *Iron Trade Rev.*, **81**, 376–78 (1927); *Feuerfest*, **3** [11], 187 (1927). F.P.H.

**Dead-burned magnesite as a refractory material.** A. W. COMBER. *Metal Ind.*, **31**, 146–57 (1927); *Feuerfest*, **3** [11], 186 (1927). F.P.H.

**The new plant of Dolomite, Inc.** ANON. *Rock Prod.*, **31** [3], 26–33 (1928).—The Maple Grove, Ohio, plant has the latest refinements for efficiency and flexibility of operation. F.P.H.

**Perforating brick and arch brick.** E. LEBER. *Tonind. Ztg.*, **51** [83], 1513 (1927). —Correct and incorrect methods are discussed. F.P.H.

**Standard tests for refractory brick.** H. KNUTH. *Tonind. Ztg.*, **51** [85], 1543–45; [88], 1598–1600 (1927).—The following standard tests for refractory materials are discussed: (1) chemical analysis, (2) softening point, (3) specific gravity, (4) compressive strength at room temperature, (5) softening of refractories under load, (6) determination of the resistance of the material to temperature changes, (7) determination of the coefficient of expansion, (8) determination of the resistance of the material to the action of slag, (9) determination of the resistance of the material to the action of acid and alkalis. F.P.H.

**Investigating the softening point of refractories under load.** W. MIEHR, H. IMMKE, AND J. KRATZERT. *Tonind. Ztg.*, **51** [89], 1618–20 (1927).—The effect of the following factors on the load test of refractories is studied: (1) size and shape of test specimen, (2) rate of heating the test pieces. Recommendations covering the following points concerning the load test are made: (1) size and shape of test specimen (cylinder, 35.7 mm. diameter and 31.7 mm. high), (2) electrical heating furnace (10–12 cm. diameter and 25 cm. in length), (3) the load should generally be 2 kg./cm.$^2$, (4) the temperature should be measured with an optical pyrometer, (5) the temperature should be increased at a rate of 10° per minute, (6) the results of the test should be expressed by (*a*) the temperature at which failure begins = *Ta*, (*b*) the temperature at which the test piece has been compressed 40% of its original length = *T*40, (*c*) the value *T*40–*Ta* which represents the temperature interval over which the specimen fails a definite amount. F.P.H.

**Temperature diffusivity and thermal conductivity of silica refractory material at high temperatures.** A. T. GREEN. *Trans. Ceram. Soc.* [Eng.], **26** [3], 159–67 (1926–27). —The modern well-fired silica product has a relatively high coefficient of thermal conductivity and temperature diffusivity at the higher temperatures. The extra heat treatment which this product receives appears to have a decided determining influence on its heat conductive properties. An investigated product, which appears to possess a relatively large amount of cristobalite has an exceptionally good conductivity and a very high value for the coefficient of temperature diffusivity at high temperatures. Inefficient heat treatment results in the production of a very poor conducting product, which has a remarkably low value for the coefficient of temperature diffusivity. The rate of increase of temperature diffusivity of a very porous product with temperature at higher temperatures is very pronounced. This points to the influence of pore spaces in helping the transmission of heat at high temperatures (1100°). The data of the coefficients of thermal conductivity and of temperature diffusivity, together with the rates of increase of thermal conductivity and temperature diffusivity with temperature are reported. R.F.S.

**A comparison of the temperature diffusivities and thermal conductivities of silica and fireclay refractories.** A. T. GREEN. *Trans. Ceram. Soc.* [Eng.], **26** [3], 168–76 (1926–27).—The diffusivities of silica and fireclay products are compared. In general, the diffusivities of silica products, both at lower (700°) and higher (1200°) temperatures, are higher than those of fireclay products. It is emphasized that there are decided variations in the values for individual samples of both kinds of refractory materials, and thus there are examples of fireclay products which have higher values for this constant than some silica products. The influence of the value of the apparent specific gravity on the value of the coefficient of thermal conductivity of both silica and fireclay materials is discussed in detail. It is shown that the apparent specific gravity of a well-fired silica brick is considerably less than that of a fireclay brick and, consequently, this tends to give lower values for the coefficient of thermal conductivity of silica products. Some of the superior well-fired silica brick are better conductors of heat than the average fireclay product at lower temperatures (800°). Many silica brick and fire brick have approximately equal conductivities at lower temperatures (800°). Most silica brick, except those which have received ineffective firing, are better conductors than fire brick at higher temperatures (1200°). Poorly fired silica bricks are comparatively poor conductors. Silica brick in general show a greater rate of increase of diffusivity and thermal conductivity with temperature than fire brick. It is indicated that a material possessing a low porosity is not necessarily a good conductor of heat. In many cases, the reverse is true, particularly at high temperatures. The rate of increase of temperature diffusivity and thermal conductivity is seen to be very high in the case of certain materials possessing high porosity. Materials with close sandy textures, possessing comparatively high porosities have, in the majority of investigated cases, shown either relatively high diffusivities and thermal conductivities or very pronounced rates of increase of diffusivity and thermal conductivity with temperature at high temperatures. R.F.S.

**The influence of oxidizing and reducing atmospheres on refractory materials.** A. E. J. VICKERS. *Trans. Ceram. Soc.* [Eng.], **26** [3], 177–84 (1926–27).—The experiments were made with a cone mixture containing added amounts of pure ferric oxide. Experiments are described relating to the effects which different atmospheres produce when a refractory material containing pure ferric oxide is heated in them. $N_2$, $O_2$, and air have no detrimental effect, $CO_2$ is comparatively harmless, while CO, $SO_2$, $H_2$, and $H_2O$ produce a very marked drop in the refractoriness of the materials investigated, the effect of $H_2O$ being especially pronounced in this respect. The effects seem proportional to the amount of ferric oxide contained in the material. R.F.S.

**The spalling of silica refractory material at low temperatures.** A. T. GREEN AND H. EDWARDS. *Trans. Ceram. Soc.* [Eng.], **26** [3], 185–202 (1926–27).—The factors influencing the spalling of silica products at low temperatures, *i.e.*, diffusivity, volume changes, and elasticity, are considered. Expansion data for eight products have been obtained. These data indicate differences in the constitutions of these materials, particularly with respect to the relative amounts of tridymite and cristobalite present. The amount and influence of the firing which the products have received are discussed on the basis of the data of expansion, the true specific gravity, and the lime contents. The $\alpha$ to $\beta_1$, $\beta_1$ to $\beta_2$ tridymitic transformations together with the $\alpha$ to $\beta$ cristobalitic transformations are given some quantitative significance from the point of view of expansion data. The cristobalitic change is shown to be particularly effective in causing spalling, while the tridymite change also causes it, if to a less extent. Data for the coefficient of temperature diffusivity of the materials are given. There is apparently no connection between the diffusivity and the spalling tendency under the conditions of these experiments. The elasticity of the product plays an important part in the spalling of silica products at low temperatures. The influence of the amount and nature of the matrix is discussed in this connection. R.F.S.

**The control of silica brick making, based on load-test indications. I.** A. J. DALE. *Trans. Ceram. Soc.* [Eng.], **26** [3], 203–209 (1926–27).—The present growing industrial demand for silica brick is due to the stability under stress at temperatures up to or exceeding 1600°C, possessed by properly manufactured material of this type, and to other characteristics, *e.g.*, maintenance of porosity and permeability at high temperatures, conferred by this fundamental property. The manufacture of a high grade silica brick becomes a matter of producing in the most economical way a product which combines good appearance with maximum resistance to deformation, disrupture, cracking, or "denaturing" at the temperatures, stresses, and other conditions encountered in industrial structures. A simple theory of the sequence and nature of the changes occurring during the economical firing of lime-bonded silica brick is discussed. From the silica brick manufacturer's viewpoint, the important indications are that quartz can convert directly to cristobalite under the influence of temperature alone and that the temperature-stability limits of tridymite and cristobalite in the presence of a solvent glass are conditioned by the nature of the glass. **II.** *Ibid.*, 210–16.—The grog consists originally of the larger grades of the crushed rock. If, after firing, this grog still contains any considerable quantity of unconverted quartz, it constitutes a potential source of internal disruptive stress during subsequent industrial use at high temperatures, particularly if the brick is under an additional mechanical or thermal stress. After a given kiln firing, the mechanical stability of the brick during the initial stages of its industrial use is really governed by the following factors: (1) the degree or the velocity at which the larger rock fragments in the raw brick mix convert to cristobalite during the kiln treatment; (2) the degree to which the matrix reaction: quartz→(cristobalite)→saturated glass→tridymite has progressed during the kiln firing. The possibility of this sequence of changes occurring within the larger granules, under the solvent action of the natural nonsiliceous impurities, is not excluded. The greater the extent to which these phenomena can be made to proceed under a given kiln treatment, the better the quality of the product. It is, however, necessary to add one important proviso, *i.e.*, the velocity at which these changes progress must not be such as to result in an unduly friable or mechanically weak material. The means of controlling and accelerating conversion of the larger fragments to cristobalite is considered in detail. **III.** *Ibid.*, 217–24.—The term "matrix" is taken to define all the material in the original mix which can pass through a sieve having 90 meshes to the linear inch. This limit is based chiefly on a consideration of the cumulative grade analyses of commercial silica brick mixes. For use at temperatures above 1400°C and moderate stresses, then so far as can be judged by the available load-test data, the matrix reaction cristobalite→glass→tridymite may proceed during use without marked disruptive effects. At these high temperatures the viscosity of the glassy bond, which results from the addition of lime to crushed quartzite rocks, would appear to be sufficiently low to readjust itself under the internal stresses accompanying devitrification. For use at continued moderate temperatures and moderate or high stresses, the available data favor the use of a silica brick with a high tridymite matrix. At temperatures 1000–1400°C no trace of subsidence has been recorded during the load-test examination of laboratory-made and commercial products, covering a fairly wide range of chemical composition and including lime-bonded, clay-bonded, and possibly lime-clay and lime-iron oxide bonded materials. For use for structures involving a frequent heating and cooling schedule in conjunction with external mechanical stress, low temperature spalling tendency must obviously be reduced to a minimum. One of the most obvious causes of low temperature spalling of silica bricks is the internal stress developed during the low temperature $\alpha$–$\beta$ inversions of cristobalite and tridymite. **IV.** *Ibid.*, 225–38.—The types of matrix which may be demanded by different conditions of industrial service fall under one of the following headings: (1) the tridymite matrix, (2) the potential tridymite matrix, (3) the matrix least likely to induce rapid

tridymite formation during industrial use at moderate temperatures, (4) the matrix with a glassy portion having exceptional "elastic" properties at low temperatures and desirable viscous properties at high temperatures. The methods by which these different types of matrix might be economically developed are considered. R.F.S.

**Calculation of mean temperatures in flat furnace walls.** S. R. HIND AND R. S. TROOP. *Trans. Ceram. Soc.* [Eng.], **26** [3], 249–53 (1926–27).—The work reported is restricted to a consideration of simple flat firebrick walls whose extent is large in proportion to their thickness. R.F.S.

**Variable qualities of fireclays.** ANON. *Brit. Clayworker*, **36** [430], 324 (1928).—The pure silicate of alumina is the ideal type of clay. It is very refractory while the double silicates of alumina with their bases are readily fused at comparatively low temperatures. The extent to which impurities may be present without rendering a fire clay useless for its finer applications may be 4% and not exceeding 5%, though 3–3½% is the most desired, of iron oxide, lime, magnesia, and alkalis. Some fire clays may require addition of alumina, others addition of silica to make them satisfactory for use. Experiments were made to determine effect of size of grog mixed with fire clay and fired to 1400°C. The clay alone expanded 0.70% at 950°C; a mixture of 80% clay and 20% of 30-mesh grog showed an expansion at 900°C of 0.47%; a mixture of 60% of this clay and 40% ⅛-in. grog expanded 0.46% at 990°C. R.A.H.

**Preparation of saggers according to fundamental properties of clays.** Bur. Stand., *Tech. News Bull.*, No. 130, pp. 17–18 (1928).—Fifteen clays on which a large number of test determinations have been made were used in a total of 14 combinations of 2 clays each, 1 of high porosity and 1 of low porosity, in the preparation of sagger bodies. Consideration was given to thermal expansion, transverse strength, and modulus of elasticity in preparing these bodies. Comparison was made of bodies containing either coarse or fine grog. Small saggers prepared from these bodies were fired at 1225°C and tested for resistance to thermal shock. The results are (1) all saggers had failed either previous to or with the quenching at 850°C; (2) the average failure of the saggers containing the fine grog occurred at a temperature approximately 100°C lower than the bodies containing the coarse grog; (3) the two bodies containing clays having dissimilar rates of thermal expansion failed at a higher temperature than was anticipated, but lower than might be expected in bodies containing clays having similar rates of expansion. It was also found that grog sizing did not appreciably effect the porosity of the fired sagger bodies. R.A.H.

**Tentative specifications for clay fire brick for malleable furnaces with removable bungs and for annealing ovens.** *Proc. A.S.T.M.*, **27** [1], 810–14 (1927).—The purpose of these specifications is the selection of clay fire brick that are suitable for service in malleable furnaces under general conditions of operation and furnace design. Factors which directly or indirectly effect the life of the brick are listed under the following captions: (*a*) fuel or firing, (*b*) furnace design or construction, (*c*) character of charge, (*d*) operating conditions. These specifications do not include a requirement for slag resistance due to the lack of a suitable test that can be regarded as satisfactory for brick used in malleable furnace service. The bungs and sidewalls must withstand high operating temperature, hence a rigid softening point requirement. They must be resistant to rapid temperature changes, hence the spalling requirement. A maximum limit for percentage of silica is given as well as a minimum limit for cold breaking strength. The methods of testing are included. R.A.H.

**Tentative specifications for clay fire brick for stationary boiler service.** *Proc. A.S.T.M.*, **27** [1], 815–21 (1927).—The purpose of these specifications is the selection of clay fire brick for general boiler service. Some of the factors which directly or indirectly affect the life of the brick are the following: (*a*) design or construction of the setting; (*b*)

fuel and firing; (*c*) operation. In these specifications brick are divided into siliceous and nonsiliceous grades with no other requirement as to analysis. The most important causes of failure of bricks are spalling and slag action. A spalling test is therefore specified, but no slag test is included due to the fact that no satisfactory test has been developed. Size tolerance, test requirements for moderate and high heat boiler settings, and methods of testing are outlined. R.A.H.

**Tentative specifications for clay fire brick for marine boiler service.** *Proc. A.S.T.M.*, **27** [1], 822–25 (1927).—The purpose of these specifications is the selection of clay fire brick for marine boiler service. Some of the factors which directly or indirectly affect the life of the brick are as follows: (*a*) design or construction of the setting; (*b*) fuel and firing; (*c*) operation. The most important causes of failure are softening, spalling, slag action, and shrinkage. Size tolerance, test requirements for moderate heat duty and high heat duty boiler settings, and methods of testing are outlined. R.A.H.

**Tentative definitions of terms relating to refractories.** *Proc. A.S.T.M.*, **27** [1], 839–40 (1927).—Definitions are listed for (*a*) plastic or bond fire clay; (*b*) flint fire clay; (*c*) diaspore clay; (*d*) nodular fire clay; (*e*) spalling, thermal and structural; (*f*) pyrometric cone equivalent. R.A.H.

**Stourbridge fire clays and the manufacture of glasshouse pots.** M. H. EDWARDS. *Jour. Soc. Glass Tech.*, **11** [44], 400–406 (1927).—Fire clays from this district were used as early as the middle of the 16th Century. The clays are mined from depths of 125–300 feet. They are weathered from 6 to 12 months or longer. D.J.McS.

**Survey of manufacture and use of glasshouse pots in Great Britain.** W. E. S. TURNER. *Jour. Soc. Glass Tech.*, **11** [44], 415–24 (1927).—Pots in Great Britain are still made almost entirely by hand, only two or three companies having attempted to use molds. Covered pots are generally made. The clays used are largely confined to those from the Stourbridge district, but a little foreign clay is used. Grog is mostly prepared from burnt lumps but potsherds are preferred in some cases. The most favored ratios of raw clay to grog is 4:1 or 3:1. The time used for soaking mixtures of clay and grog varies from 2 to 26 weeks. No special systems of ventilation or humidity drying are used and the pots are frequently made in poorly lighted basements. D.J.McS.

**Zirconium.** J. H. DE BOER. *Ind. Eng. Chem.*, **19** [11], 1256–59 (1927).—The method for the preparation of very pure ductile zirconium is described. The method of treatment starting with the ore and the purification of zirconium salts is given. A number of physical properties such as melting point, specific gravity, electrical resistance, etc., have been determined. R.J.P.

**Magnesite industry in Czechoslovakia.** JOSEPH MATEJKA. *Stavivo*, p. 61 (1926).—Czechoslovakian magnesite occurs in the districts Novohrady, Gemer, Abauj, near Ružiná, Hnúšt, Jelšava, Ochtina, and Košice. It is crystalline and similar to the Austrian magnesite of Styria. Its composition is the following:

| | Sample I | Sample II |
|---|---|---|
| $SiO_2$ | 2.32 | 1.31 |
| $TiO_2$ | 0.07 | 0.08 |
| $Al_2O_3$ | 0.46 | 0.51 |
| $Fe_2O_3$ | 3.77 | 4.62 |
| CaO | 0.44 | 0.50 |
| MgO | 44.42 | 44.50 |
| $SO_3$ | 0.27 | 0.14 |
| $CO_2$ | 48.51 | 48.56 |
| | 100.26 | 100.22 |

The largest quarries are in Ružiná where magnesite arose by change of limestone through thermal solutions and where it is deposited in carbonate, graphitic, and clayish slates.

These quarries belong to the West Bohemia Chamotte and Kaolin Works, which possesses also kilns for burning of burned magnesite at Lovinobanja and Hnúšt and a factory of magnesite bricks at Hnúšt. Magnesite is burned caustically at 900°C in shaft-kilns; then it is dead burned in other shaft-kilns at about 1500°C. Then follows crushing, and cleaning by a magnetic separator. The daily output of the Czechoslovakian magnesite factories amounts to 410 T. of clinkered magnesite and 12 T. of magnesite brick. BA.

**Refractories for the glass industry.** W. J. REES. *Glass*, **3** [11], 452–53 (1926).—R. discusses the requirements for silica refractories for use in the glass industry. The softening point or P.C.E. value (determined in a manner similar to A.S.T.M. standard test) should be equal to that of cone 31 at least. The cold-crushing strength should be not less than 2000 lb. per sq. in. and the modulus of rupture not less than 300 lb. per sq. in. for a good brick. Silica bricks and shapes should be of such texture and degree of firing as to carry a load of 25 lb. per sq. in. at 1600°C without deformation. A test piece, about 3 x 1 x 1, cut from a brick to be used in a high temperature furnace, after being slowly heated to 1500°C and maintained at that temperature for two hours, should not show when cold a greater linear expansion than 1%. The surfaces of the bricks should be true so that a minimum of cement is required. Modern practice is to set the bricks dry and apply the cement as a grouting. The maximum variation of any dimension should not exceed ±2%. It is important that great care be taken in storing silica bricks as dampness causes deterioration in mechanical strength and increases spalling tendency. The change in properties seems to be due to hydration and solution of the bond. Silica refractories should always be stored in dry, ventilated places. *Ibid.*, [12], 496–97.—Types of silica cements suitable for use with silica refractories are: (*a*) mixture of crushed ganister or other quartzite and plastic fire clay, (*b*) mixture of crushed ganister or other quartzite and lime, (*c*) mixture of fine-grained silica sand and plastic fire clay, (*d*) crushed silica brick and plastic fire clay. Cement should not be too fine-grained or refractoriness will be reduced and drying shrinkage excessive. Plastic clay or lime should be in such proportions that refractoriness is not lowered below cone 29. Refractoriness of these cements decreases under load. Cements in walls and crowns of furnaces are subjected to considerable pressure from expansion of bricks. Care is required if silica, fire clay, and lime are used in the same cement, as the refractoriness is suddenly reduced. The determination of volume changes in a furnace designed for underload tests gives the most information. A.J.M.

**Slag corrosion of refractories.** A. J. DALE. *Glass*, **3** [11], 453 (1926).—A paper presented before the Institute of Gas Engineers by D. is discussed. Suggestions for lessening the interaction of refractories and slag were as follows: (1) structural modifications such as readjustment of internal furnace contours, elimination of dust from heating gases, the application of air or water cooling to reduce the hot face temperature of refractories, the conservative use of thermal insulation, control, and limitation of working temperatures, control of slag composition, and (2) control of the chemical, mineralogical, and physical properties of refractories. A.J.M.

**Notes on the genesis of Grecian magnesite.** J. R. THOENEN. Amer. Inst. Min. and Met. Engrs., *Tech. Pub.*, No. 67, 9 pp. (1928).—For abstract see *Ceram. Abs.*, **7** [4], 237 (1928). H.H.S.

**Progress in fuel investigation in 1927.** HASLAM AND WARD. *Power*, **67** [2], 79 (1928).—Water-cooled walls materially reduce furnace maintenance, wall radiation losses, clinkering, and stack losses. The use of Carborundum refractories for the clinker zones and pits of stoker-fired furnaces has proved to be excellent practice. The solid brick appears to be longer lived than the perforated. The use of overfire air injection increases the efficiency and eliminates bad smoke nuisances, especially with the poorer grades of

coal. The design and details have been improved in nearly all types of stokers, particularly increased length and improved air distribution. The areas of chain grates has increased approximately 10% and the increased use of water-cooled drive shafts is noted. The use of pulverized coal has increased. The installation of turbulence principle burners has greatly increased. The Bergius process for the liquefaction of coal has been put on a commercial basis. The coke dry quenching process at Rochester is described. The Stratton furnace which burns crushed (not pulverized) coal by suspension and submerged flame combustion is mentioned. G.W.W.

**Burroughs suspended furnace arch.** ANON. *Power*, **67** [3], 120 (1928).—A drawing of the method of suspending a furnace arch by I-beams and dovetail grooves in the tile which are held in place by semicircular wedges, is shown. This construction requires small space, and removal and replacement are facilitated. G.W.W.

**Hofft furnace arch block hanger.** ANON. *Power*, **67** [4], 159 (1928).—A block hanger to facilitate the installation of furnace arch blocks from the inside of the furnace is illustrated and a drawing shows how the block and hanger are put in place. G.W.W.

**How to avoid failure in monolithic furnace linings.** CUMMINGS. *Power*, **67** [5], 175 (1928).—A résumé of practical experience tells why the same materials cannot be used for furnace linings and baffles, the importance of thoroughly mixing and proportioning the bonding material and refractory, with comments on compacting, drying, and the use of wooden forms and reinforcing material. Plastics suitable for furnace lining do not make good baffles because the temperature of the gas at the baffles never becomes high enough to complete vitrification and attain full strength. The secret of a good plastic refractory is accurately balanced refractory material and bonding agent, so that the expansion ratios are balanced at all temperatures. Hand made plastics from old fire brick fail because of improper composition and improper mixing and they have a tendency to pulverize too finely which destroys their strength. The denser the material is compacted the stronger and longer lived it will be. Linings should be dried out with a slow fire to remove the moisture. In drying allow one hour per inch of thickness. Metal forms prevent the escape of moisture. When wooden forms are used it is a good idea to paint them with waterglass and water to partly fireproof them to prevent them from burning during the drying out process. Reinforcing rods cause difficulties because of the different rates of expansion, and if used it is almost necessary to coat them with paper to allow slip space. Adequate support must be provided for walls as plastic materials have no direct bonding power with brick or other parts of the boiler. A diagram shows differences of temperatures on baffles and furnace walls and the kinds of materials used. Pictures show mullers to mix, seven-pound hammer to knit the materials together, and the shaved exposed surface for the moisture escape. G.W.W.

**Coal ash and its fusion.** LANGTRY. *Power*, **67** [5], 192 (1928).—Contrary to the usual view, the fusion temperature may increase with the percentage of ash, and high sulphur content may go hand in hand with high fusion temperature; so it would seem that too much stress is being placed upon ash and sulphur as the primary causes of clinker formation. A table gives ash fusion temperatures for various coals and varies from 1957–2958°F (last one not fused). Ash in coal plus an additional amount of slate, fire clay, bone, etc., may have a higher fusion temperature than the intrinsic ash in the coal itself. G.W.W.

**Progress in glass house refractories.** W. K. BROWNLEE. *Amer. Glass Rev.*, **47** [21], 15–16 (1928); *Glass Ind.*, **9** [3], 60–62 (1928); *Ceram. Ind.*, **10** [3], 316–18 (1928).—The evolution of manufacture of glass from pot furnaces to tank furnaces, from all hand-made ware to semihand-made ware, and then to automatic or machine-made ware is discussed. The heat and clay used for the glass pots and tanks and the glass contained

within and their relations to each other are discussed. Insulation of tank blocks and the use of the newer refractories are also dealt with. Some future improvements are also prophesied. P.F.C.

PATENTS

**Refractory muffle.** CHARLES W. SAXE. U. S. 1,661,309, March 6, 1928. A refractory muffle structure for use in high temperature furnace operations comprising a plurality of flat dense refractory plates having a length equal to the width of the structure and provided with tongues and grooves interfitting to form continuous top and bottom walls of the muffle, and a plurality of plates of similar material extending between the top and bottom which are provided with tongues and grooves interfitting to form the muffle sides, the side plates being arranged upon the bottom plates and adapted to support the top plates and provided with wide flat edges containing tongues adapted to engage grooves in the inner flat surfaces of the top and bottom plates, thereby providing an integral self-supporting structure adapted to effectively resist the heat changes encountered in high temperature operations.

**Method of making furnace lining.** GEORGE P. SUPPES. U. S. 1,661,859, March 6, 1928. The method of forming a furnace lining which consists in molding a refractory composition into blocks, hardening the blocks by baking them in the presence of steam under pressure until the bond has matured, and then laying the blocks in the furnace to form a lining.

**Retorts, etc.** SOUTH METROPOLITAN GAS CO. AND R. H. B. LAMPREY. Brit. 279,201, Dec. 14, 1927. Gas-fired retorts, etc., are protected from erosion at the parts subjected to the highest temperature by the application of a highly aluminous material, either in the form of paste or thin tiles. A suitable paste consists of 20 parts of plastic refractory clay, 60 parts of calcined alumina, and 20 parts of grog.

**Ceramic materials.** F. SINGER. Brit. 282,403, Feb. 15, 1928. To produce a ceramic material having a low coefficient of expansion, steatite, or other compound of magnesium or of the alkaline earths, is mixed in the solid state with aluminium compounds and heated until three phases are formed, one phase being a glass having a refractive index of 1.53 to 1.55, and the other two phases being crystallites, the first crystals of the sillimanite type, including mullite, and the second crystals of the forsterite and enstatite type.

**Fused silica.** BRITISH THOMSON-HOUSTON CO., LTD. Brit. 282,733, Feb. 22, 1928. A method of converting cloudy or milky quartz crystal into clear, vitreous silica consists in heating the material to a temperature adjacent to, but not exceeding 1700°C, then cooling it to a temperature below 270°C, and finally fusing it in a vacuum. The fusion is carried out in an electric furnace, and the product obtained may be extruded in the form of rods or tubes.

**Refractory substances.** DEUTSCHE GOLD UND SILBER SCHEIDEANSTALT VORM. ROESSLER. Brit. 282,795, Feb. 22, 1928. Objects are made from zirconia by first mixing dry zirconia with small amounts of hydrolyzable substances such as zirconium tetrachloride, aluminium chloride, magnesium chloride, etc., mixing into a plastic mass with water and finally shaping and burning. Other substances such as thoria may be added.

**Fused silica.** QUARTZ ET SILICE. Brit. 283,148, Feb. 29, 1928. Relates to the method of producing fused silica in which sand is packed around a carbon rod which is raised to a high temperature by the passage of an electric current. According to the invention, an oxidizing atmosphere is maintained in the furnace during the melting period in order to obtain a finished product which does not contain either free carbon or silica. Air or oxygen may be circulated through the furnace, but the desired result is

preferably obtained by adding a small quantity of water to sand before it is introduced into the furnace.

**Fused silica.** QUARTZ ET SILICE. Brit. 283,174, Feb. 29, 1928. A method of producing pressed articles from fused silica consists in heating a silica blank up to a temperature at which the material volatilizes freely, and then transferring the blank quickly to the press. The apparatus comprises a furnace, a hydraulic press, and a cooling or annealing furnace. The furnace consists of a crucible, which may be made of zirconium or graphite, contained in a casing which is filled with heat-insulating material the whole being revolvable on an axis by means of a handle. The crucible is inductively heated by high-frequency currents passing through a winding on the outside of the casing, and it is fitted with a stopper having a peep hole. The press is preferably operated by hydraulic pressure. The furnace into which the articles are placed after pressing, is heated up to a temperature of 1200°C by gas burners. In use, a silica blank is placed in the crucible and is heated to a temperature of 2200°C, at which it volatilizes. The crucible is rotated in order to prevent the blank from sticking to the crucible, and this is also prevented by the free volatilization of the silica in contact with the hot walls of the crucible. The rotation also shapes the softened silica blank. The hot blank is transferred to the press, and is shaped by pressure between the heated molds. The shaped article is then transferred to the furnace, where it is reheated and then allowed to cool slowly. Articles may also be shaped by pressing and blowing. In this case, the silica blank is pressed into a mold by a plunger which grips a part of the blank against an apertured plate placed on the mold. The pressed blank, or parison, thus formed is blown to shape by compressed air supplied through passages in the plunger.

## Terra Cotta

**Some experiments on terra cotta slips.** E. C. HILL. *Jour. Amer. Ceram. Soc.*, **11**[4], 260–63 (1928).—A series of experiments on slips for terra cotta, in which variations in composition in relation to their effect on vitrification, crazing, cracking, and color are studied.

**Troubles experienced in manufacture of smooth-drawn roofing tile.** JOSEPH MATEJKA. *Stavivo*, p. 27 (1926).—In the manufacture of smooth-drawn roofing tile of clay, the oblong projection in the middle of the tile is cut away in order to make a nose which serves as a hook for hanging up the tile. M. found that the part of the tile where the projection had been was 1–1.7% larger and was consequently less watertight and of smaller specific gravity than the other part of the roofing tile. BA.

**Advantages of stoneware shapes in the condensation of waste gas.** H. WUSTENFELD. *Deut. Essigind.*, No. 30 (1927).—The use of stoneware in various branches of the chemical industry is described. Various chemical stoneware shapes used in the industries are illustrated. F.P.H.

**Clay roofing tile.** PAUL ULBRICH. *Tonind. Ztg.*, **51**[85], 1545–46 (1927). F.P.H.

## White Wares

**White wares industry in 1927.** C. C. TREISCHEL. *Ceram. Age*, **11** [1], 9–11 (1928).—The past year in the white wares industry has been characterized by mergers and consolidations both consumated and contemplated, construction of new and modern plants, plant additions, the installation of modern labor-saving equipment, and by the closing of a number of plants which were becoming obsolete and inefficient. T. regards 1927 as the beginning of a new era in the white wares industry. Some of the important mergers and plant expansions are described. Three pieces of equipment new to the industry as a whole are a rotary drum filter, a new method of oil firing introduced by the Carborundum Co., and an electric kiln for use in the firing of glazed wall tile. T.

points out their usefulness and describes their advantages. No outstanding new products have appeared; the ivory colored body has grown in favor until one-half the domestic production consists of this type; and several electrical porcelain products formerly dust-pressed are now made by casting. Other factors of importance are tariff, prices, costs, and imports. Foreign producers are securing more control in the dinner ware and tile market but have no appreciable control in the electrical porcelain and sanitary ware market. Prices have been reduced until the manufacturing profit is small, and the white wares industry as a whole will probably show a loss for the year, in spite of efforts to reduce costs by the introduction of machinery and elimination of skilled labor. For the first time in the history of American dinner ware a complete dinner service is being exported to Europe. A.E.R.W.

**A modern wall tile plant at Keyport, N. J.** STAFF ARTICLE. *Ceram. Age*, **11** [1], 11–14 (1928).—The history, development, and present structures and equipment of the Architectural Tile Co., at Keyport, N. J. are described and illustrated. The plant contains 10 kilns, 14 ft. 6 in. in diameter and 11 ft. high to the crown; is about 360 ft. long and 230 ft. wide; and has exceptionally fine lighting facilities and equipment for unloading and storing clay. A.E.R.W.

**Effect of surface on adhesion of plaster to tile.** Bur. Stand., *Tech. News Bull.*, No. 130, pp. 18–19 (1928).—Three grades of tile (hard, medium, and soft) were obtained with 5 types of surfaces (combed, grooved, wire cut, smooth, and glazed). Results of adhesion of plaster and stucco and a combination of these are given. R.A.H.

**Japanese porcelain industry.** ANON. *Keramos*, **6** [12]. 457–58 (1927). F.P.H.

**Manufacture of floor tile.** P. P. BUDNIKOFF AND I. ENDOWITZKY. *Tonind. Ztg.*, **51** [88], 1597–98 (1927).—The clay body with 5–7% moisture content is pressed in a hydraulic press to 30–40 atmospheres; the pressure is released to allow the removal of the air and again applied at about 250 atmospheres. The tile are dried at 40°C for about 4 days until the moisture content is reduced to about 3%. The tile are fired in saggers to cones 4 or 5 with an oxidizing atmosphere. The type of clay best suited to the manufacture of floor tile is described. The following table gives the analyses of some clays used for this purpose.

TABLE I

| Clay | $SiO_2$ | $Al_2O_3$ | $Fe_2O_3$ | CaO | MgO | Ignition loss | Alkali | Color fired at 1200°C |
|---|---|---|---|---|---|---|---|---|
| 1 | 60.60 | 27.22 | 2.10 | 1.40 | .48 | 8.55 | .25 | Yellow body |
| 2 | 53.47 | 26.17 | 10.34 | .61 | .61 | 8.43 | .26 | Red body |
| 3 | 52.36 | 34.48 | 1.10 | .44 | .44 | 9.55 | 1.33 | White body after addition of flint and feldspar |

TABLE II

COMPOSITION OF SOME COLORED FLOOR TILE

| Material | White | Blue | Red | Brown | Yellow | Light green | Dark green |
|---|---|---|---|---|---|---|---|
| Clay 3 | 93.0 | 91.3 | | | | 40.2 | 38.9 |
| Clay 1 | | | | | 100 | 40.2 | 38.9 |
| Clay 2 | | | 100 | 96.15 | | | 4.75 |
| Feldspar | 3.5 | 2.2 | | | | 9.27 | 8.79 |
| Quartz sand | 3.5 | 4.6 | | | | 8.22 | 6.32 |
| Pyrolusite | | | | 3.85 | | | |
| Cobalt frit | | 1.9 | | | | 1.95 | 2.34 |

The cobalt frit was made of 1 part cobalt oxide and 7 parts zinc oxide. F.P.H.

**On the origin of European porcelain.** M. A. PFEIFFER. *Keram. Rund.*, **35**, 103–106 (1927). H.I.

**Standardization of hotel chinaware.** ANON. *Keram. Rund.*, **35**, 338–39 (1927).—The specifications for hotel china promulgated by the Committee of German Industry to decrease the number of sizes are given. H.I.

**The glazing of unfired ceramic products.** KARL JACOB. *Keram. Rund.*, **35**, 347–49 (1927).—The one-fire method of firing ceramic products is described and some of the economic advantages of this over the two-fire method are enumerated. The addition of small amounts (1–3%) of agglutinants such as gum arabic, dextrine, glue, or starch paste assists in preventing cracking and peeling during drying and curling during firing. Coating of the dried body with an agglutinant also assists in preventing softening of the body in glazing. In firing, the glaze should not melt before organic matter has been burned out and all volatile substances driven off; otherwise bubbles will form in body and glaze. The same body and glaze combinations used in two-fire cannot usually be used in one-fire ware. The one-fire process has long been used for heavy clay products but is comparatively new for white ware. In general the two-fire process is more easily controlled and less likely to give defects than the one fire. H.I.

**"Metallization" of pottery and glassware.** ANON. *Pottery Gaz.*, **53** [609], 479 (1928). —British Airships, Ltd., has acquired a process termed "metallization," claiming that it is a new invention whereby a wide range of materials may be treated in a metal bath. The distinctive characteristic of the process is that, unlike processes of coating and plating, the metal and the material interpenetrate to a certain thickness, thereby forming to that extent a quite new material combining the qualities of both the original material and the applied metal. It is not a coating which peels off. Samples of pottery and glassware decorated by this process were shown in London. The company has no fixed plan regarding the exploitation of the invention. The specimens exhibited were made in Paris, but were not then on the market. It is claimed that "metallization" makes pottery or glassware unbreakable, but this is apparently true only to the extent that it is reinforced by the metal coating; by this process fabrics for airships, etc., clothes, timber, rubber, paper, etc., can be "metallized." E.J.V.

BOOK

**Yearbook of the Potteries and North Staffordshire, 1928.** Stoke-on-Trent: *Staffordshire Sentinel*, 1928. Price one shilling. H.H.S.

PATENTS

**Insulator.** ESTILL I. GREEN. U. S. 1,659,731, Feb. 21, 1928. An insulator comprising a supporting pin, a cylindrical cob of dielectric material adapted to be mounted on the supporting pin, the cob having a laterally extending flange of dielectric material at its lower edge where it is secured to the supporting pin, and a metallic button-like member adapted to be mounted on the top of the cob at a distance from the supporting pin approximately equal to the radius of the lateral flange in order to permit the line conductor and tie wire to be secured thereto, the button having a flange projecting outwardly and downwardly adjacent to but separated from the dielectric flange to protect the cob from moisture.

**Insulator.** KENT A. HAWLEY. U. S. 1,661,823, March 6, 1928. (1) Means for insulating and supporting a current carrying conductor from a grounded conductor, comprising a string of insulator units each having a conducting surface of high resistance which forms a continuous and unbroken path for leakage current between the current conductor and the grounded conductor. (2) An insulator unit having its entire surface provided with a glaze embodying a high resistance conducting material. (3) An insulator for high voltage lines comprising a disk of porcelain having a path of resistance material extending over its exposed surface from the central portion of the upper surface to the central portion of the lower surface.

**Mechanical shaker for ceramic tile.** LOUIS S. JONES, CARL G. HENRIKSON, AND GARFIELD W. FISHER. U. S. 1,662,779, March 13, 1928. The combination of means for supporting a mounting board for tiles, means for rocking the board, means for varying the speed of the rocking motion including a lever connected to the supporting means,

a crankshaft, a crank adjustably mounted thereon, and connections between the crank and the lever, substantially as set forth.

**Pottery shaping.** W. J. MILLER. Brit. 283,150, Feb. 29, 1928. Apparatus for shaping pottery articles comprises a rotating mold a shaping profile and means for removing the excess of plastic material during the shaping operation. A helical screw is mounted within a casing carried by a bracket adjustably secured. To allow the use of molds of varying sizes an annular space is provided between the chuck and the trough and such space may be spanned by a disk resting either on the mold or trough. A sponge carried by a bracket adjustably mounted may be kept in contact with the material on the mold and moistened by a spray from a nozzle. A sprinkler may be employed for directing a spray of water to the top of the disk and a second spray from a nozzle may supply water to the trough in order to liquefy the material therein. The liquefied material in the trough is caused to pass to a channel disposed at a lower level than, and tagentially to, the trough.

**Pott ery molding.** W. J. MILLER. Brit. 283,151, Feb. 29, 1928. A machine for the manufacture of pottery comprises means for extruding plastic material in or on to molds, means for severing charges of material, means for shaping the charges and jiggering means. As shown, the molds supported in trunnioned trays carried by endless chains, are brought in turn beneath a container for the plastic material then under a shaping plunger and finally under a profile. The material is extruded from the container through an orifice and is severed by a wire or blade. A feed shaft within the container is driven intermittingly from a shaft through a cam, lever, ratchet gear, and bevel gears; a slight return movement is imparted to the shaft at the end of each operation by a spring-controlled brake band.

**Pottery shaping mechanism.** W. J. MILLER. Brit. 283,182, Feb. 29, 1928. Pottery-shaping apparatus comprises carriers for conveying molds continuously in a path iadjacent movably-mounted mechanism for shaping the articles, and means for periodically moving such mechanism in unison with the molds and carriers. The periodic movement of the shaping mechanism permits the shaping operation to be effected without nterrupting the continuous conveyance of the molds.

## Equipment and Apparatus

**Drying clay under definite conditions. I.** R. S. TROOP AND F. WHEELER. *Trans. Ceram. Soc.* [Eng.], **26** [3], 231–38 (1926–27).—The object was to observe the drying which had taken place and the water distribution in a series of clay pieces after different periods of time, when air travelling at a definite velocity and previously brought to a definite temperature and humidity was passed over one face of each of the series of clay pieces, which were prevented from drying except at this face; and further to carry out a series of such observations for different temperatures, humidities, and velocities of the air, the direction remaining constant. The supply of air was obtained from a small patent blower working off the water mains and giving a maximum of about four liters (1/4 cu. ft.) of air per minute. A large container was connected to the blower and used as a reservoir to lessen some of the small irregularities in the supply. In order to check the velocity of the air through the apparatus, the air after leaving this reservoir was made to pass through a capillary tube of about 1/16 in. bore and 12 in. long, the difference in pressure between the air entering and leaving the capillary being measured on a liquid manometer. After passing through the capillary, the air went directly to the humidifying apparatus and drying chamber. The whole of this portion of the apparatus was contained in a large water bath, heated by gas, and covered with asbestos sheeting to check heat loss to some extent. A batch of prepared fire clay was used. Six samples of clay used for each experiment were in the form of cylinders. These were carefully made from the wedged clay in molds formed of a 5 in. length of 1 in. exterior diameter

glass tubing split along its length to form two half cylinders. The clay was left in the glass, one end being covered with a glass slide so that only one end of the clay cylinder was left exposed to the air. One cylinder was removed at the end of each period of 6 hours, the maximum drying time being 36 hours. Air at relative humidities of 90, 80, 70, and 60% was used at each of the temperatures 30°, 40°, and 80°. The cylinders were numbered from 1 to 6 and were removed in the same order in all experiments. After being prepared, cylinder 6 (the last to be removed) was weighed before any drying took place and then weighed at the end of each period of 6 hours. In this way the rate at which water was evaporating from the single face was obtained. When a cylinder was removed from the drying chamber, the clay cylinder was carefully taken out of the glass, and seven small samples of it were quickly cut from definite positions and put into weighing bottles. These samples gave the water content of the cylinders. **II.** *Ibid*, 239–48. The results for the rate of drying of the clay with the drying air at 90% relative humidity, and at various temperatures are considered in detail, and show that under the conditions of the experiment, the evaporation of water follows the usual type of law, *viz:* $W = A(Ps - Pd)$, where $A$ is 0.0158, $W$ = rate of evaporation in kilos per sq. meter of surface per hour, $Pd$ = vapor pressure of the water in the air, and $Ps$ the saturation vapor pressure at a given temperature. For water, Himus and Hinchley give 0.031 and Carrier 0.0178, neglecting the velocity factor. Results are given for the distribution of water in clay, drying at one face only, in air definitely conditioned and the curves obtained from these figures considered. R.F.S.

**Dispersed heat for drying refractory materials.** ANON. *Pottery Gaz.*, **53** [608], 299 (1928).—The utilization of dispersed heat for drying refractory materials is a question which has given rise to a great deal of controversy, and none of the devices hitherto invented has given entire satisfaction. A newly invented drier has chambers in which the gases are collected in a central main conduit communicating with a series of smaller conduits trending in their direction toward the various chambers, the circulation in the interior of these conduits being carefully controlled. The warm air penetrates into the chambers and is there charged with moisture, thus increasing its density, and consequently it causes it to descend toward the bottom, where there are provided orifices communicating with a collecting conduit, where a certain depression is maintained by suitable means. These orifices, made in the flooring, are also provided with regulatable valves, the object of which is to accelerate the rapidity of the circulation of the gases. In spite of its numerous advantages, this system presents certain drawbacks. The drying decreases from the top downward, and the water withdrawn from the top rows of articles is liable to recondense upon those at the bottom. Furthermore, the drying of the articles by the gases upon their admission may become rudimentary and excessive, and thus give rise to inevitable drawbacks. There is, however, reason to hope that, when it is possible to obtain a perfect type of this system of drying, it will be destined to render very valuable service to all concerned. E.J.V.

**Conditions of flow into the vertical capillary tube of the Saybolt thermo-viscometer.** WINSLOW H. HERSCHEL. *Ind. Eng. Chem.*, **19** [7], 837–40 (1927).—In previous work on the flow into vertical capillary tubes it has been assumed that the drainage error and "end effect" were negligible, and differences between experimental and calculated times of flow were ascribed to inaccuracy in measuring the diameter of the capillary. In this work it was found that these sources of error caused a reduction of about 9% in the time of flow, as compared with values calculated on the assumption that such errors were negligible. R.J.P.

**Pyro-optical pyrometer.** ANON. *Power*, **67** [3], 120 (1928).—A type of optical pyrometer which is self-contained and incorporates all of the parts necessary for accurate

temperature reading in one unit is described. A picture shows the pyrometer in position and a cross-section through the instrument shows its construction. The normal range of the instrument is 2000–3200°F. Special ranges for higher temperatures can be provided. G.W.W.

**Jeffrey "Drag-On" portable scaper conveyer.** ANON. *Power*, **67** [3], 120 (1928).—Reduced weight of frame, increased size and strength of the conveying chain, and larger screening chute are features of this conveyer which is shown in a photograph. G.W.W.

**Uehling electrically operated Apex $CO_2$ recorder.** ANON. *Power*, **67** [4], 160 (1928).—An illustration of the arrangement of the $CO_2$ meter with motor driven vacuum pump and regulator is shown. With this apparatus the installation is simplified and the steam water and drain lines are eliminated. The instrument consists of three principal parts, suction pump, the $CO_2$ meter, and the indicator and recorder. The $CO_2$ is absorbed in a dry cartridge placed in the meter. The instrument employs a pyro-porous filter on the end of the sampling line to exclude soot and ash. G.W.W.

**Use of noble metals for electrical contacts.** E. F. KINGSBURY. *Min. and Met.*, **9** [255], 150 (1928).—The paper describes the results of an investigation of the behavior of the gold, silver, and platinum metals as electrical contacts in communication circuits. F.P.H.

**Mechanical preparation of colloidal solutions, suspensions, and emulsions.** R. E. SERRA. *Quim. et Ind.*, **4** [47], 331 (1927).—S. discusses the principles involved in the preparation of colloidal solutions and the methods used in their preparation. He describes in detail the mechanical methods so far tried and reviews results obtained by the use of mills. The Premier Mill is described and its fields of utilization enumerated. G.A.B.

**The use of compressed air.** R. WILSON. *Glass*, **3** [10], 419 (1926).—W. gives examples of compressed air calculations. A.J.M.

**The selection of electric motors.** ANON. *Glass*, **3** [10], 423 (1926).—Types of alternating current motors are described. Advantages of each are given. A.J.M.

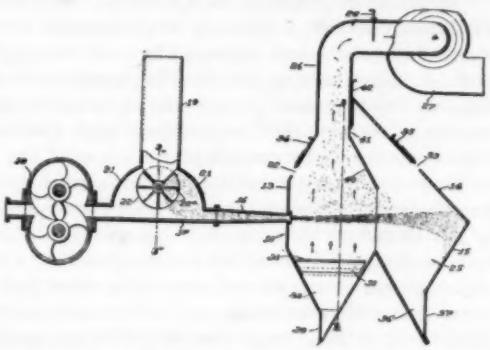
**Pyrometer resistance.** ANON. *Glass*, **3** [10], 429 (1926).—The use of a low resistance instrument is recommended because the torque developed is larger than that developed with high resistance. Hence, friction on the pivot points does not cause as great an error in the former case. In the high resistance type the needle must be perfectly balanced and the axis of the moving coil kept approximately vertical to prevent error due to weight of the needle. A.J.M.

**Plating room control.** F. P. TAYLOR. *Abrasive Ind.*, **9** [2], 52–53 (1928).—Definite control of the various factors and operations in the plating room and their relation to maximum efficiency in production are discussed. Control of time is stressed, not only its effect on continuous production but also on the plating that requires five or six minutes, with the result that a minute or two difference is a matter of 20% of the whole operation. Control of voltage or source of power is important because of operation at top voltages. Spacing of cathodes should also be noted. Temperature control is important, especially where the color and luster of the plate are unquestionably influenced by temperature. Automatic temperature control of solutions as well as chemical control are stressed. This temperature fluctuation has bearing on adjusting solutions. Initial and final surface should be carefully watched. P.F.C.

**The use of rubber linings in apparatus for the chemical industry.** A. BRESSER. *Notiz. chim.-ind.*, **2**, 631–32 (1927).—A description of the electrolytic deposition method and the pressure method of coating metals with rubber. (*C.A.*)

PATENTS

**Air-blast classifier.** ALBERT H. STEBBINS. U. S. 1,660,682, Feb. 28, 1928. An air-blast classifier for separating fine dustlike materials, comprising in combination, a casing constructed to form a long narrow treatment chamber within which an air blast may travel a substantial distance along a straight uninterrupted path, a nozzle having a reduced discharge end located at one end of the casing to direct a jetlike blast of dust-laden air lengthwise of the treatment chamber so that the heavier particles will be shot by the force of the blast against the opposite end wall of the casing, means for forcing air bearing the materials to be separated through the nozzle under high pressure to impart to the different materials the same initial velocity so that as they travel along the path of the air jet the finer particles will be carried laterally out of the direct path of the air jet by the expansion of the air within the air jet, means for introducing air into the treatment chamber below the air jet, and means for exhausting air from the upper portion of the casing to produce rising air currents that flow upwardly around the air jet to carry upwardly the lighter particles as they work out of the direct path of the air jet.



**Air classifier.** ALBERT H. STEBBINS. U. S. 1,660,683, Feb. 28, 1928. An air classifier, comprising in combination, a closed receptacle having a central opening at its lower end and tapered downwardly, converging walls that direct materials into said opening and also having an air discharge opening near its upper end, the lower end of the receptacle being provided with a multiplicity of air inlet apertures disposed to deliver currents of air through the particles that slide down the walls of the receptacle toward the material discharge opening, the apertures being constructed to impart a spiral movement to the air passing through them to throw the heavier particles outwardly by centrifugal force, a closed casing surrounding the apertured portion of the receptacle, and disposed out of the path of the falling materials, means for forcing air into the casing to deliver air under pressure to the apertures, and means for delivering the materials to be treated into the upper part of the receptacle so that the heavier particles settle within the receptacle in opposition to the rising air currents while the lighter particles are carried by the air through the air discharge opening.

**Air classifier.** ALBERT H. STEBBINS. U. S. 1,660,684, Feb. 28, 1928. An air classifier, comprising in combination, a receptacle having an air inlet opening adjacent its lower end, means for delivering the materials to be treated into the upper part of the receptacle, a hollow spreader supported within the casing below the feed means and having sloping side walls to deflect outwardly the falling particles, means for exhausting air from the upper portion of the receptacle, and a pipe leading from the exterior of the receptacle into the interior of the spreader and adapted to produce air currents around the lower edge of the spreader to diffuse the particles.

**Air classifier.** ALBERT H. STEBBINS. U. S. 1,660,685, Feb. 28, 1928. A multiple treatment classifier, comprising in combination, a receptacle having a serpentine air passage, means for introducing air and the materials to be classified into the passage

to travel along the same so that the heavier particles will be thrown outwardly toward the outer curved wall of the passage by centrifugal force, means for exhausting at successive points along the passage the air traveling adjacent the inside of the bends in the serpentine passage, and means for introducing additional air into the air passage at opposite sides thereof to replace the air exhausted therefrom.

**Air classifier.** ALBERT H. STEBBINS. U. S. 1,660,686, Feb. 28, 1928. A multiple treatment classifier, comprising in combination, a tortuous conduit having a series of rounded loops or bends connected by more sharply bent loops or bends adapted to impart an abrupt turn to the air as it passes from one to another of the first-mentioned loops or bends, means for introducing air and the materials to be treated into the conduit to travel within its passage at high speed so that the heavier particles will be thrown outwardly by centrifugal force toward the outer wall of the loops, and means for removing from the conduit at the inner side of the loops the air which has been freed from the heavier particles by centrifugal force.

**Air classifier.** ALBERT H. STEBBINS. U. S. 1,660,687, Feb. 28, 1928. A multiple treatment classifier, comprising in combination, a tortuous conduit that gradually decreases in size from one end toward the other and provided with a series of bends or loops, means for introducing air and the materials to be treated into the larger end of the conduit to travel lengthwise thereof at high speed so that the heavier particles will be thrown outwardly by centrifugal force toward the outer wall of the loops, exhaust pipes mounted transversely of the conduit within the bends of the loops and provided with longitudinally extending slots arranged to exhaust from the conduit the air traveling near the inner wall of the loops and from which the heavier particles have been removed by centrifugal force, and each slot being positioned to face away from the main path of the air traveling within the conduit.

**Pug mill.** MARTIN MADSEN. U. S. 1,662,120, March 13, 1928. A pug mill comprising a mixing chamber having a sectional bottom composed of a central section having a discharge port therein, and two interchangeable reversible side members adapted to be reversed edge for edge and end for end; two paddle shafts, adjustably mountedin the end members of the chamber; paddles on the shafts; a longitudinally sliding gate adapted to control the discharge port; means to adjust the position of the gate; and means to adjust the upper surfaces of the lower edges of the side bottom members with reference to the upper surface of the adjacent edges of the central member.

**Furnace (of the multiple closed hearth rabble type) for continuously drying and heating wet materials such as filter-press cakes or lithopone green cake.** GRASSELLI CHEMICAL CO. Brit. 265,771, Feb. 9, 1926. (*C.A.*)

## Kilns, Furnaces, Fuels, and Combustion

**Fuel ratios in the firing of refractories.** G. A. BOLE. Amer. Refrac. Inst., *Circ.*, No. 1, March (1928).—The whole problem of kiln efficiency is so intimately tied up with five or six major items that the naming of any figure as a kiln efficiency factor is a precarious proposition. The following items are of major importance in obtaining good or poor results in kiln firing: (1) kiln design, (2) kiln proportions, (3) grade of fuel used, (4) firing schedule, (5) method of stoking fires, (6) method of setting ware. Table I contains data obtained by the Bureau of Mines crew on five plants firing refractory wares. Under "plant practice" will be found figures supplied by the plant owners prior to the running of the tests. The figures in the last column are results of the work of the Bureau crew. These data were obtained from a survey of plants in the Kentucky-Ohio district. The figures were supplied by the plant management in each case from accurately recorded plant data. Much of the data obtained during the survey is not given due to questionable accuracy. From the above figures and in light of a great deal

of information which might be classed as second-hand information, B. offers the following for consideration. These figures are for a medium sized round downdraft kiln (30 to 32 ft.), fired with a good grade of coal: cone 12–14, 1600–1800 lbs. per 9-in. equivalent; cone 8–10, 1300–1500 lbs. per 9-in. equivalent; cone 4–6, 1000–1200 lbs. per 9-in. equivalent. The figures are based on the assumption that it requires about 8 days to properly mature a refractory at a temperature of cone 12–14 in periodic kiln practice; approximately 6–7 days for a cone 8–10 firing and 5 days for a cone 4–6 firing. The cone temperatures referred to are assumed to be at a point in the top of the wicket and a variation throughout the kiln of three cones. It is interesting to note that the variations in efficiencies above recorded (Table I) in the case of a cone 4–6 firing is 1200–2200 lbs. per thousand 9-in. equivalents. The three or four kilns upon which accurate and comparable information is at hand, however, would seem to indicate that it is easier to get a uniformly well fired product from a well proportioned round downdraft kiln than from a rectangular kiln of equal capacity. The major difference seems to be in the greater ease of proper heat distribution in the round downdraft type of kiln. It is claimed by tunnel kiln builders that B.t.u.'s can be traded between coal, oil, producer gas, and natural gas when figuring fuel ratios in tunnel kiln practice. Assuming a figure of 1100 lbs. of coal per 1000 brick, the ratio for natural gas would be 13,200 cu. ft. per M. (coal at 12,000 B.t.u. per lb. and the gas at 1000 B.t.u. per cu. ft.). Oil of 19,000 B.t.u. per lb. and a gravity of .90 (25° Bé) will give fuel ratio of approximately 100 gal. per M. Figures obtained from practice indicate that in periodic kiln operation, the fuel for a cone 6–8 firing for natural gas is about 17,000 cu. ft. per M. A tunnel kiln operation firing ladle brick to a very low temperature (1900°F) claims a fuel ratio of 6000 cu. ft. per M. This is about the same figure as several ratios checked on plants firing face brick in tunnel kilns to about the same temperature. Several tunnel kiln practices are reported to be considerably better than the 100 gal. of oil above mentioned. One figure of 80 gal. of an 18° Bé oil is reported but has not been checked (cone 12 firing). The figure for a round downdraft oil-fired kiln in Table I is a short firing using a 24° Bé oil.

TABLE I

| Type of kiln | Kiln capacity | Firing time (hrs.) | Cone | Plant practice coal used (lbs.) per M 9-in. equiv. | By Bureau crew (lbs.) |
|---|---|---|---|---|---|
| Round downdraft | 32,000 | 150 | 9–6 | 1450 | 1270 |
| Rectangular downdraft | 42,000 | 163 | 9–5 | 1775 | 1700 |
| Round downdraft | 65,000 | 192 | 8–6 | 2180 | 1510 |
| " " | 60,000 | 156 | 11–8 | 1200 | 980 |
| " " | 40,000 | 85 | 10–6 | 1513 | 1370 |
| " " | 54,000 | 156 | 6 | 2200 | |
| Rectangular downdraft | 60,000 | 168 | 7 | 1800 | |
| Round downdraft | 65,000 | 228 | 10–12 | 2000 | |
| " " | 48,000 | 132 | 2 | 1500 | |
| " " | 50,000 (gas) | 168 | 6 | 18,000 cu. ft. | |
| " " | 55,000 | 210 | 7 | 2100 | |
| " " | 50,000 | 168 | 6–4 | 1450 | |
| " " | 45,000 | 228 | 4 | 2200 | |
| Rectangular downdraft | 50,000 | 216 | 6 | 2100 | |
| Round downdraft | 76,000 (oil) | 110 | 6–8 | 125 gal. | |
| " " | 54,000 | 168 | 6–4 | 1200 | |

NOTE: All kilns firing largely 9-in. brick. F.P.H.

**Air space not an insulator at high temperatures.** ANON. *Blast Fur. Steel Plant*, **16** [2], 287 (1928).—For some time there was a belief that since air is a poor conductor of heat, air spaces built into the walls of boilers, furnaces, etc., would prevent or reduce heat loss through the walls. Ray and Kreisinger ran a series of exhaustive tests on air

spaces used as an insulation and showed that this artifice defeats its own purpose at high temperatures because of the fact that the hot surfaces of the air space radiate heat so rapidly that a greater amount is lost across the space by radiation than would be conducted were the air space to be filled with material of relatively high conductivity such as fire brick. The quantity of heat passing through a portion of a solid wall by conduction depends upon the difference between the temperatures of the two planes limiting the portion of the wall, while the quantity of heat that passes across the air space in the wall depends on the difference between the fourth powers of the absolute temperatures of the surfaces enclosing the air space. Such information is hardly necessary to confirm the fallacy of attempted insulation in furnace walls by the use of so-called "dead air space." Besides the intense radiation through air at high temperatures, there is also rapid convection. The average velocity of the molecules in air, at 1100°F is approximately 60 miles a minute (this calculation can be made from information to be found in many standard texts on physical chemistry); it might be well, therefore, to use the term "live air space" instead of "dead air space." F.P.H.

**Coal production and classification.** ANON. *Min. and Met.*, 9 [255], 144–45 (1928).—Abstracts of papers on coal presented at the meeting of the A.I.M.M.E. are given. The following subjects are discussed: (1) safety in mining, (2) conditions in Russia, (3) coal washing, (4) scientific use and classification of coal, (5) demand for more research on coal. F.P.H.

**Pure coal as a basis of classification.** E. V. TIDESWELL AND R. V. WHEELER. *Min. and Met.*, 9 [255], 150 (1928).—Inorganic materials must be regarded as impurities in coal and their presence introduces errors into the composition as found by analysis which are not adequately corrected for by the usual calculation to an ash-free basis. The magnitude of the errors involved is greater than is perhaps generally realized. By calculation to the basis of the "pure coal," *i.e.*, the coal free from the associated inorganic matter, which is greater in amount than the derived ash, the errors can be reduced considerably. This applies particularly to the shaley and pyritic constituents, the two main inorganic impurities in coal. Calcium carbonate cannot so readily be corrected for and it is advisable (and practicable) to free the sample from carbonate. The corrections indicated in this paper are not absolute and, though their use minimizes the errors involved in the analysis of impure coal (and is therefore always advisable), it is desirable, when exact knowledge of the composition of a coal is required, to reduce the magnitude of the corrections to be applied by working on as pure a sample of the coal as can be obtained. F.P.H.

**Tunnel kilns in the brick and refractory industries.** WERNER MORITZ. *Tonind. Ztg.*, **51** [90], 1634–36 (1927).—The tunnel kiln is compared with other types of kilns used in the brick and refractory industries. F.P.H.

**Increasing the life of an old Hoffman kiln.** P. THOR. *Tonind. Ztg.*, **51** [91], 1658 (1927). F.P.H.

**Firing kilns loaded with stoneware.** N. NEIMANN. *Tonind. Ztg.*, **51** [92], 1677–78 (1927). F.P.H.

**Buell system for pulverized coal.** SCOTT. *Combustion*, **17** [2], 100 (1927).—A test with pulverized slack coal by the engineers of Maize Products Pottery, Ltd., is reported. The burner is illustrated. The number of B.t.u. per lb. of coal as fired using this system is given as 11,855, flue gas analysis gives 12% $CO_2$, 7.1% $O_2$, and 86% boiler efficiency. G.W.W.

**The relation of moisture to combustion.** P. NARRACOTT. *Combustion*, **18** [3], 176 (1928).—A discussion of some published figures concerning the increase in calorific value of the fuel arising from the reaction of the fuel with water present in it, and concludes that no energy gain whatever results from the presence of water in fuel. G.W.W.

**Dvorkovitz system of low temperature carbonization.** A. D. BLACKALL. *Combustion*, **18** [3], 180 (1928)—A brief description of the demonstration of this system before a gathering of experts at Slough, England, where there is a setting of two retorts, each with a capacity of 5 tons a day. In this process the coal is crushed to $^1/_2$- to 2-inch lumps and treated in a vertical retort heated outside by producer gas, and on passing down is scrubbed by heated gas. This gas is superheated and removes the oils. The retort has two parts, upper and lower, separated by a valve. The off-take is at the bottom and leads the gases to the washers, condensers, and purifiers. The lower temperatures used prevent the cracking of the oils, and the coke is readily powdered. G.W.W.

**Characteristic furnace curves as an aid to fuel control.** ARMSTRONG. *Engineer*, **144** [3745], 445 (1927).—A. suggests a method of plotting curves by which accurate and careful control of furnace heating can be effected. He illustrates with a figure with 5 curves showing the temperature of furnace gases, outside temperature of ingot, the temperature 1, 3, and 5 feet inside the ingot and calls it the heating cycle of a 30-T. steel ingot. It is claimed that the amount of fuel burned over any period or heating cycle will give a constant, which under control can be fixed or watched. The operating efficiency of any furnace can be checked from a characteristic curve drawn by plotting the furnace output per furnace hour or the fuel burned per unit of output. The essence of furnace control is to keep the fuel per hour as low as possible. The necessary data are total fuel used, quantity of material heated, and furnace hours. Curves show actual results and the saving from a furnace before and after fuel control by this system. Fuel testing is advocated. Some improvements in furnace design and usage are suggested. A. emphasizes the importance of fuel control, and says that in France and Germany where special attention is paid to fuel control a saving of 15% and higher has been accomplished. This results in economies thus reducing the effectual price of fuel to the industries. G.W.W.

**Combustion control formulas. V. Simplifying the heat loss formulas.** UEHLING. *Power*, **67** [3], 94 (1928).—Formula 1: $0.24 \pm \frac{58.46}{CO_2} \times (T-t)$ = B.t.u., of sensible heat in dry gas per pound carbon unit. $(T-t)$ represents the difference in temperature between the gas on leaving the boiler and that of the atmosphere. A figure shows a sensible heat loss curve in dry flue gas per degree of temperature. Formula 2: $10{,}160 \times \frac{CO}{CO+CO_2}$ = B.t.u. heat loss per pound carbon heat unit due to incomplete combustion. A curve plotted from this curve is shown. Formula 3: $H_f[10{,}640-9t+4.3\times(T-212)]$ = B.t.u. heat loss due to hydrogen in the fuel per pound carbon unit. $H_f \times 10{,}649$ B.t.u. of latent heat is unavailable to the boiler, and cannot be reduced. A table giving the ratio of H to C for different fuels is given. Formula 4: $\text{Av.} \times \frac{(117)}{(CO_2)} \times (T-t)$ = B.t.u. heat loss due to humidity in the air per pound carbon unit, is small, and can be ignored for control purposes, but must be considered when making a heat balance. Formula 5: $\sqrt{Bd} \times CO_2$ = index of the rate of combustion. Formula 6: $\sqrt{Bd}$ = index of the normal exit gas temperature. Formula 7: $\frac{3018}{CO_2} + 9H_a$ = cu. ft. of air per pound carbon unit. Formula 8: $\frac{243.6}{CO_2} + 8H_a$ = lb. of air per pound carbon unit. Formula 9: $1 + \frac{243.6}{CO_2} + 9H_f$ = lb. of wet gas per pound

carbon unit. Formula 10: $\frac{2100}{CO_2 \times (1+3H_a)} - \frac{100+237H_a}{1+3H_a}$ = per cent excess air. Formula 11: $\frac{21}{1+2.37H_a} = \text{Max} \cdot CO_2$. The use of these formulas is explained. G.W.W.

**Advances in firing technique and increases in production in ceramic kilns.** GRAAFEN. *Keram. Rund.*, **35**, 75 (1927).—A self-feeding and self-stoking furnace for intermittent and continuous ceramic kilns burning powdered coal and actuated by a hydraulic pump is described. H.I.

**A new type of kiln.** M. HEINE. *Keram. Rund.*, **35**, 87–89 (1927).—In the firing of ceramic ware, care must be taken to avoid too rapid heating during watersmoking and removal of carbon. Local cool spots and the entrance of cold air must be prevented. These conditions cannot well be avoided in kilns in which cold air enters under the grates. Tunnel kilns afford good control of temperature and firing conditions but cannot be conveniently installed in many plants. The semirecuperative type of kiln is recommended in which the fuel is partly gasified and mixed with pre-heated air. Most of the combustion takes place in the kiln chamber and not in the fuel bed. Savings of 40% in fuel and 30% in burning time have resulted from the use of this type of furnace. Bituminous or sub-bituminous coal or wood may be used as fuel. H.I.

**Heating ceramic kilns (single) with generator gas of greater calorific value.** RUDOLF CZERNY. *Sprechsaal*, **61** [1], 3–6; [2], 23–24 (1928).—An article on heating of ceramic kilns with generator gas which has been preheated by waste gases thereby increasing its calorific value. Chemical compositions of fuels employed and mathematics used in arriving at conclusions are given. Time consumed and temperature reached in firing kilns with and without preheating gases are included. C. shows that by improving the calorific value of the gas by preheating even low-grade fuels may be successfully employed for firing kilns. It is questionable whether the improvement would be as great in the tunnel kiln as in the ordinary single kiln. R.A.H.

**Industrial fuels. I.** R. H. FERNALD. *Ceram. Age*, **10** [6], 195–97 (1927).—The available resources and the nature and general trend of recent developments are surveyed. F. outlines the production and reserves of the different states and says that in 15 years, North Dakota lignite, which has a 35–40% moisture content, may be one of our leading fuels. Taking sub-bituminous coal as a standard of 1, bituminous coal has a heating value of 1.6, anthracite and semi-anthracite a value of 1.7, and semi-bituminous a value of 1.8. Lignite and bituminous coal underlies 1000 times the area underlain by anthracite. Peat is widely distributed and is a good working fuel. It will be used at a rate much faster than it is forming in bogs. F. shows how greater efficiency in coal utilization is being secured. He then takes up coal consumption and waste and shows how savings can be effected. Over 20% can be saved by good engineering methods. Similar surveys of oil and natural gas are given. Ten more lectures will be given on this subject at Rutgers University. A.E.R.W.

**Coal and coke-oven gas.** F. C. WEBER. *Ceram. Age*, **11** [1], 20–22 (1928).—W. describes the raw materials, methods of manufacture, properties of products, and present tendencies in the coal gas and coke-oven gas field. Both coal gas and coke-oven gas are derived from the destructive distillation of coal, the former in retorts and the latter in coke ovens. In the future a large part of the gas will be made in coke ovens. Water-gas plants cost less, and have a more flexible output, but use a more expensive fuel and give no by-products in return. They will be used to take care of peak conditions. A table showing the composition and heating values of typical gas fuels is given. A.E.R.W.

**New tunnel kiln at Crooksville pottery.** ANON. *Pottery, Glass, and Brass Salesman*, **37** [2], 27 (1928).—The firing of bisque and glost ware successfully in the same kiln has

ust been accomplished by the Crooksville China Co. It means that with a single kiln he plant can turn out glazed white ware perfectly and enjoy all the saving in fuel cost that comes from operating a single kiln in place of several beehive kilns. It is a direct-fire Harrop tunnel kiln and is 320 feet in length. A complete conveyer system is being worked on whereby the ware will not have to be carried from the kiln. Boilers are to be eliminated by the use of waste heat for drying and general factory heating.

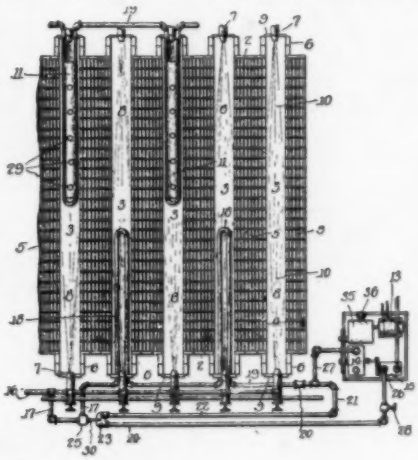
P.F.C.

**Mechanical gas producers.** J. F. ROGERS AND V. WINDETT. *Glass*, **3** [10], 436 (1926).—Problems arising from the substitution of completely mechanical gas producers for the hand-operated type are discussed. The main problems are (1) to gasify a wide range of coals including those less desirable from chemical and physical standpoints, (2) to make good gas without deterioration in quality or quantity incidental to cleaning of fire, (3) to reduce hard work of gas maker and amount of labor per unit weight of coal, (4) to increase gasification rate per unit of cross-sectional area of gasification zone without sacrifice in quality of gas, (5) to secure these results in a producer which, while mechanically driven, is simple, durable, and accessible in operating parts. Sampling and errors are discussed. A table shows improvements by the introduction of a completely mechanical gas machine.

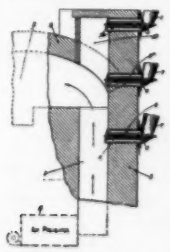
A.J.M.

## PATENTS

**Regenerative furnace.** ROBERT D. PIKE. U. S. 1,648,191, Nov. 8, 1927. In a regenerative reversing furnace, a combustion and exhaust port leading to the furnace, a damper mounted in the bottom of the port and means for moving the damper so as to vary the area of the port.



**Method and apparatus used in the firing of brick and other material.** FRANK BERNARD LAMBERT AND FERDINAND ERNST LAMMERT. U.S. 1,659,604, Feb. 21, 1928. The method of firing brick and the like in temporary kilns which consists in burning therein a fuel while suspended in the air, supplying a heat regulated quantity of water for forming steam within a zone of combustion, and utilizing the steam for aiding in burning fresh fuel and in promoting uniformity in the firing process.



**Method of burning powdered coal.** WILLIAM B. CHAPMAN. U. S. 1,661,408, March 6, 1928. The method of burning powdered coal, which consists in forming outside of the combustion chamber proper an upwardly directed confined column of preheated air of restricted area moving with sufficient velocity to support substantially all the fuel particles, feeding powdered coal into such column and igniting the fuel therein, whereby the column will arrest the fall of substantially all the fuel particles and prevent them from escaping without being ignited, and then passing the kindled fuel and air into the combustion chamber proper.

**Apparatus for firing ceramic and other products.** CHARLES T. HOLCROFT AND CHARLES E. DOLL. U. S. 1,662,063, March 13, 1928. In the art of firing articles, a

tunnel kiln formation of the muffle type, means for advancing the articles through the tunnel of the formation, and means for establishing a circulation of air within the tunnel with the air supply admission adjacent an end of the tunnel and with pressure of the air greater than that of atmospheric pressure, the air being in direct contact with the advancing articles.

**Tunnel kilns.** WOODALL-DUCKHAM, LTD., AND A. M. DUCKHAM. Brit. 280,044, Dec. 30, 1927. In an annular tunnel kiln having an open firing zone and muffled preheating and cooling zones, gases are withdrawn from the kiln on both sides of the firing zone. The kiln comprises a firing zone supplied with heating-gases from a combustion chamber through vertical side wall flues, a preheating zone with horizontal wall flues through which the heating-gases from the firing zone pass on their way to the chimney flue, and a cooling-zone also with wall flues which convey cooling air and deliver it through the conduit to the combustion chamber. In the preheating and cooling zones are outlet ports in controlled communication through flues with the main stack flue, and through these ports gases are withdrawn in order to minimize convection currents in the cooler portions of the kiln. The heating gases from the flues are caused to impinge upon the sides of the goods-supporting platform, and pass in part to the kiln chamber through the clearance spaces between the platform and the walls, and in part to radial flues formed beneath the platform and branching from an annular flue. The ports leading to the wall flues are situated at the same level as the delivery ports from the flues. Transverse walls of a temporary nature are built upon the traveling hearth to divide the kiln into a number of chambers, and at the entrance and exit a tight joint made with these walls by adjustable lintels. Escape of gases from the flues at the entrance and exit of the kiln may be prevented by dampers or slides.

**Kilns.** A. E. OSMAN. Brit. 283,009, Feb. 22, 1928. In a continuous kiln each chamber has two end upcast shafts with openings through which the gases from side fire-places can pass into the shafts and so to the kiln chamber, one shaft in each chamber being in communication, through a transverse flue, with longitudinal flues beneath the floor of the preceding chamber of the series. The other shaft communicates at its lower end with longitudinal floor flues, and some of the gases drawn downward through the chamber pass through ports into the flues and mix with fresh furnace gases in the upcast shaft. The longitudinal flues communicate with the kiln chamber through ports and transverse passages, and each transverse flue can be put into communication with a main flue through a damper-controlled passage. Air from a chamber which is cooling down can be passed to any other chamber of the series through roof ports, flues, and a removable connection between the mouth and a transfer flue.

## Geology

**Mining and preparation of St. Peter sandstone in Arkansas.** D. D. DUNKIN. Amer. Inst. Min. and Met. Engrs., *Tech. Pub.*, No. 55, 10 pp. (1928).—St. Peter sandstone has been marketed for glass manufacture since 1910, and with more success since 1921 by the Silica Products Co., of which D. is president. A seam most suitable for glass was found 12 ft. down, and mining was resorted to. The paper outlines a rather radical departure from approved methods of drilling, placing holes, and blasting, and a diagram is given showing the arrangement of the holes and the order of firing. The dynamite used has been brought down to 0.42 lbs. per T. of sand. The sand is 99.38% $SiO_2$ and 0.028% $Fe_2O_3$. When mined, it is graded by moving up an inclined plane to which the fines adhere while the coarser grains slide and roll. It is loaded into railroad cars which are carefully cleaned and paper-lined. H.H.S.

**Salt and potash in Canada.** ANON. *Chem. and Ind.*, **47**, 125 (1928).—The deposit of salt in the Malagash peninsula, Nova Scotia, is estimated to contain 60 million T. of

pure salt, and 300 million T. of lower grade salt. The deposit is said to be the only one on the Atlantic seaboard. It contains indications of potash salts, and German interests are said to have been inquiring into the situation. H.H.S.

**The Decorah formation in N.E. Iowa.** G. M. KAY. *Science*, **67**, 16 (1928).—The formation is divided into three members, named in descending order, the Ion, Guttenberg, and Spechts Ferry members. The Ion beds are argillaceous northward, more calcareous southeastward; Guttenberg is brownish fine limestone; both members being of basal Trenton (Rockland) age. Spechts Ferry, of Black River (Watertown) age, is "glass rock," shale and limestone. H.H.S.

**Geology and the world at large.** G. H. ASHLEY. *Science*, **67**, 21–24 (1928).—An appeal to geologists to restore their science to the place it enjoyed 50 years ago in the minds of cultivated men. A. says that geology is not a science, since it formulates no laws and can make no predictions, and that the wide divergences in facts, such as one man saying six million and another sixty million years, forfeit respect. H.H.S.

**Zeolite beds in the Green River formation.** W. H. BRADLEY. *Science*, **67**, 73–74 (1928).—Almost complete zeolization (analcite) of the tufaceous matrix has occurred in certain Eocene lake beds of Utah and Colorado. As these zeolites must have been formed at a temperature approximating mean annual temperature of earth's surface, their occurrence suggests the possibility that the zeolite gels of soils may under favorable conditions crystallize into definite minerals. H.H.S.

**Paul Heinrich von Groth obituary.** E. H. KRAUS. *Science*, **67**, 151–52 (1928).—Born at Magdeburg, June 23, 1843, educated at Freiberg, Dresden, and Berlin, he became professor of mineralogy at the Univ. of Strassburg in 1872. He founded the *Zeitschrift f. Kristallog. u. Mineralogie* in 1877. In 1883 he left Strassburg for Munich, where he stayed till his death on Dec. 2, 1927. He was the author of 13 textbooks, of which one is the monumental "Chemical Crystallography," in 6 volumes. His point system theory of crystal structure helped to develop X-ray analysis. H.H.S.

**Ceramic raw materials in Texas.** BYRDE HAMILTON. *Ceram. Age*, **10** [6], 220–21 (1927).—Texas possesses extensive ceramic resources to be developed. Clays of economic value in Texas are classified in five groups, as follows: common brick clays, firebrick clay, slip clay, kaolin, and fullers' earth. The clay deposits in the different geological formations are described and photographs of several clay banks shown. A.E.R.W.

**Coal mining in Russia.** JOHN A. GRACIA. *Min. and Met.*, **9** [255], 140–43 (1928).—Coal mining is controlled in Russia by district organizations known as trusts. Many seams of coal are available but working conditions are generally unfavorable. Production has greatly increased. Maps are given showing the principal coal fields of Asiatic and European Russia. F.P.H.

**Mineral production in Canada in 1927.** ANON. *Rock Prod.*, **31** [3], 47 (1928).—New output records for all time were established in 1927 in gold, copper, lead, zinc, cement, gypsum, and lime. The value of natural gas and petroleum increased. Enlarged production, in comparison to the totals for 1926, is noted in the output of many metallic and nonmetallic minerals, the latter including gypsum, quartz, cement, lime, stone, and sand and gravel. F.P.H.

**Silica sand plants at Ottawa, Ill.** ANON. *Rock Prod.*, **31** [4], 54–60 (1928).—General practices in one of the largest silica sand producing areas in the U. S. are described. F.P.H.

**Russian graphite reserves.** ANON. *Rock Prod.*, **31** [4], 80 (1928); *Economic Rev. Soviet Union*, Jan. 1, 1928.—New reserves of graphite discovered by the geologists of the United States of Soviet Russia are described. They lie along the banks of the Kureika river and amount to at least 8,500,000 tons in one locality alone. The average

carbon content is about 90%, and some of the impurities can be still farther removed by winnowing and flotation. The graphite lies at a depth of only 12 meters and the thickness averages 15 meters. Though near the Arctic circle, the deposits are in a sheltered valley which affords a relatively mild climate. The region is accessible by boat along the Yenisei river through the summer months, as well as by rail from Krasnoyarsk. Ground graphite of 95–98% carbon content is to be furnished. Tests conducted at the Leningrad Mining and Metallurgical Laboratory indicated the successful use of the graphite in carbon electrodes. F.P.H.

**Fluorspar, its mining and markets.** E. L. BROKENSHIRE. *Enamelist*, **4** [3], 10–12 (1926).—Ill. and Ky. supply about 80% of the total domestic production of fluorspar. Colo. and N. Mex. account for most of the remainder. From 7–10% of the production is used in ceramic manufacture. M.E.M.

**A lecture on china clay.** G. S. CLARKE. *Pottery Gaz.*, **53** [609], 435 (1928). E.J.V.

**Rumanian kaolins.** A. I. BRANISKI. *Bull. Chim. Soc. Române Stiin.*, **29**, 15–77 (1926).—The Rumanian kaolins have been analyzed and classified. None is of markedly superior quality, and many will find application only in the manufacture of stoneware and refractory materials. A few, however, can be used in the manufacture of porcelain, although of a variety inferior to and less translucent than that of Sèvres. (*B.C.A.*)

## Chemistry and Physics

**The effect of temperature on the optical properties of kaolinite.** T. N. MCVAY. *Jour. Amer. Ceram. Soc.*, **11** [4], 224–26 (1928).—Euhedral crystals of kaolinite were heated to various temperatures, making draw trials at frequent intervals, and the effect of temperature was studied microscopically. The results obtained indicate three classes of kaolinite: (1) the natural kaolinite, (2) the uniaxial form produced at 625°C, the metanacrite of Rinne, and (3) the change of the metanacrite into what is probably mullite and glass at 1450°C.

**New method of determination of small amounts of lead.** B. S. EVANS. *Chem. and Ind.*, **47**, 160 (1928).—Pb is quantitatively deposited on copper from a cyanide solution containing ammonium oxalate. By working in the cold the interference of Sn, Sb, Zn, Cd, and Ni is eliminated; Bi interferes. H.H.S.

**Separation of tantalum, niobium, etc., from silica.** W. R. SCHOELLER AND A. R. POWELL. *Chem. and Ind.*, **47**, 160 (1928).—The disputed volatilization of the fluorides of Ta and Nb is discussed. Evaporation with HF and $H_2SO_4$ is not accurate with small amounts of $SiO_2$. The mixed oxides should be fused with $NaHSO_4$, extracted with tartaric acid, and then the residue of impure silica should be treated with HF. H.H.S.

**Titanium precipitation by tannin.** W. R. SCHOELLER AND A. R. POWELL. *Chem. and Ind.*, **47**, 160 (1928).—Tannin quantitatively precipitates Ti from neutral oxalic or tartaric solutions. Ti therefore interferes with the tannin separation of Ta from Nb. H.H.S.

**Rapid determination of soil moisture by methyl alcohol.** G. J. BOUYOUCOS. *Science*, **67**, 167 (1928).—Methyl alcohol is more satisfactory than ethyl alcohol or other organic dehydrants. Ten g. of soil are intimately stirred with 50 cc. absolute methyl alcohol, the mixture is filtered, taking care to prevent evaporation and the density of the filtrate is taken by hydrometer. H.H.S.

**Studies on alumina and ferric oxide.** W. C. HANSEN AND L. T. BROWNMILLER *Amer. Jour. Sci.*, March, pp. 225–42 (1928).—The phase relations of the system

corundum-hematite and some compounds of $Al_2O_3$ and $Fe_2O_3$ with CaO and MgO are studied together with X-ray patterns and measurements of some of the physical properties. It was shown that precipitated alumina dried at 110°C has a definite composition ($Al_2O_3 \cdot 3H_2O$) and gives an X-ray pattern different from gibbsite and further, dehydrates at 200°C. Precipitated alumina crystallizes to the $\gamma$-form when heated for six hours from 900–950°C. The X-ray pattern and specific gravity of this form are given. Precipitated alumina changes to corundum at 1000°C–1200°C. Precipitated $Fe_2O_3$ changes to hematite when heated for one hour at 300°C. Two new compounds ($4CaO \cdot 2MgO \cdot Al_2O_3 \cdot Fe_2O_3$ and $2CaO \cdot MgO \cdot Fe_2O_3$) were prepared and their melting points, X-ray patterns, and optical properties are given. J.T.L., Jr.

**Theory of porous flow.** E. B. Libman. *Phil. Mag.*, **4** [7], 1285–90 (1927).—A mathematical theory is developed for the laws governing the flow of fluid from the interior of a body to its surface while it is drying. Such a flow is considered as due to three causes, (1) flow due to capillarity, (2) flow due to pressure gradient due to shrinkage of the material, and (3) flow due to gravity. An equation is developed which gives the rate of flow in terms of measurable quantities. J.T.L., Jr.

**Invert sugar as a substitute for mannite or glycerin in the titrametric determination of boric acid.** Anon. *Keram. Rund.*, **35,** 365–68 (1927).—Solutions of boric acid in water may not be titrated directly with $N/10$ NaOH or $Ba(OH)_2$ because of the strong hydrolysis of the sodium or barium metaborate and consequent alkaline reaction of the liquid before an equivalent quantity of the alkali has been added to the boric acid. Ordinarily mannite or glycerin is added to the boric acid solution and the complex glycerin or mannite boric acid is titrated. Mannite is expensive and large amounts of glycerin are required. Invert sugar is a satisfactory substitute and may be prepared by heating beet sugar with dilute HCl. The inversion of the sugar may be put in the boric acid solution to be analyzed or a laboratory stock may be prepared. When the former method is employed 16 g. of sugar may be substituted for 8 g. of mannite in a solution containing about 0.15 g. $H_3BO_3$. Invert sugar may be used satisfactorily in the analysis of borosilicate glasses for $B_2O_3$. H.I.

**Calculating the melting points of silicates.** W. Fischer. *Keram. Rund.*, **35,** 381–82 (1927).—Van't Hoff's law for melting point lowering is inapplicable quantitatively to most silicate systems because of the occurrence of compounds, eutectics, and solid solutions with accompanying thermal and volume changes. Quantitative predictions can only be based on the experimentally determined temperature-concentration equilibrium diagram. H.I.

**Natural history of the silica minerals.** Austin F. Rogers. *Amer. Mineral.*, **13** [3], 73–87 (1928).—For any mineral or group of minerals there are two general classes of facts to be ascertained: (1) the geometrical, physical, and chemical properties; (2) the mode of occurrence, association, and origin, or briefly what may be called the natural history of the mineral. To the geologist, the natural history of a mineral is its most attractive feature, but until the mineral is accurately defined and determined, the significance of its occurrence and origin may be lost sight of. The silica minerals are with a single exception accurately defined; they have been produced in the laboratory; they constitute the most complete example of polymorphism known. They are, moreover, of considerable geological interest, and altogether we have a fairly good idea of the rôle that the silica minerals play in nature. The occurrence, physical and chemical properties of the following silica minerals are described: (1) low quartz, (2) high quartz, (3) chalecedony, (4) tridymite, (5) cristobalite, (6) lechatelierite. Photomicrographs of the various forms of silica are given.

Tabulation of the Silica Minerals

| Mineral | Crystal form | Sp. gr. | NαNγ | Stability range |
|---|---|---|---|---|
| Opal (Pliny, 77) | Amorphous (porodine) | 2.1 –2.2 | 1.44–.46 | — |
| Chalcedony (Agricola, 1546) | Aggregate structure | 2.57–2.63 | 1.533, 1.543 | — |
| Low quartz (Wallerius, 1747) | Trigonal trapezohedral ($A_3 \cdot 3A_2$) | 2.65 | 1.544, 1.553 at 20°C | — >575°C |
| High quartz (Le Chatelier, 1889) | Hexagonal trapezohedral ($A_6 \cdot 6A_2$) | — | 1.533, 1.540 at 580°C | 575°–870°C |
| Low tridymite (vom Rath, 1887) | Orthorhombic (pseudohexagonal) | 2.28 | 1.469, 1.473 | None |
| Lower high tridymite (Mallard, 1890) | ? | — | — | None |
| Upper high tridymite (Fenner, 1913) | Hexagonal | — | — | 163°–1470°C |
| Low cristobalite (vom Rath, 1887) | Tetragonal (?) (pseudo-isometric) | 2.23 | 1.484, 1.487 | None |
| High cristobalite (Mallard, 1890) | Isometric | 2.20 (290°C) | — | 200°–275°–1625°C |
| Lechatelierite (Lacroix, 1915) | Amorphous (Hyaline) | 2.21 | 1.458 | 1625°C |

F.P.H.

**Determination of the purity of glaze materials.** ANON. *Keramos*, **6** [12], 468–69 (1927).—A few simple tests are given to determine the purity of the following glaze materials: PbO, $Pb_3O_4$, $2PbCo \cdot Pb(OH)_2$, $PbCrO_4$, $HBO_3$, $Na_2B_4O_7$, $Cr_2O_3$, $Fe_2O_3$, $FeSO_4 \cdot 7H_2O$, $K_2CO_3$, $CaCO_3$, $CO_2O_3$, $CoCO_3$, CuO, $Na_2CO_3 \cdot 10H_2O$, $MnO_2$, $Al_2(OH)_6$, $Al_2(SO_4)_3 \cdot 18H_2O$, ZnO, $SnO_2$. F.P.H.

**Purification of six platinum metals.** EDWARD WICKERS, R. GILCHRIST, AND W. H. SWANGER. *Min. and Met.*, **9** [255], 148 (1928).—The best methods for the purification of platinum, palladium, rhodium, iridium, ruthenium, and osmium are described in detail. F.P.H.

**Quantitative spectrum analysis.** F. TWYMAN AND D. M. SMITH. *Min. and Met.*, **9** [255], 149 (1928).—After discussing the development of analysis by spectrography T. and S. describe modern spectrographs and their use. The 1st part of the paper concludes with comparison spectra and the 2nd part takes up quantitative spectrum analysis. The results of a research in determination by this method of small quantities of Cd, Pb, and Fe in zinc are given, followed by a discussion of the determination of impurities in copper and brass. Steel analysis is next up, and the paper concludes with an extensive bibliography. Discussion of the paper by H. A. de Lazlo is included. F.P.H.

**The influence of temperature on the path-difference and on the schillerization in soda-orthoclase and moonstone.** SHUKUSUKE KOZU AND MINEICHI MASUDA. Tohoku Imp. Univ., *Sci. Repts.*, Series III, July, 1926. F.P.H.

**Electroplating in Japan involves simple methods.** A. P. MUNNING, II. *Abrasive Ind.*, **9** [3], 72–73 (1928). P.F.C.

**Rational analysis.** ALBERT GRANGER. *La Ceramique*, **30** [469], 56 (1927).—G. quotes authorities and gives reasons for concluding that rational analysis should be used only in cases when the qualitative composition is known, as in a porcelain body, and even then will provide only a theoretical composition which can be used as a guide but is not necessarily correct. A.E.R.W.

**Studies of the permeability of porous plates.** HOWE. *Eng. News-Rec.*, **99** [1], 18 (1927).—An apparatus for permeability determinations is described and the effect of temperature variations on values obtained is discussed. G.W.W.

**The reciprocal action of sodium metasilicate and water-soluble metallic salts.** P. N. GRIGORJEW. *Z. anorg. allgem. Chem.*, **167**, 137–44 (1927).—Depending on their behavior toward alkali metasilicates, the water-soluble metallic salts can be classified in 3 groups. (1) Salts of the alkali metals precipitate a voluminous mass of $SiO_2$ from a concentrated solution of metasilicate. The phenomenon is a coagulation and has an electrophysical character. (2) Mg, Ca, Sr, and Ba salts precipitate the corresponding alkali earth silicates from a dilute solution of metasilicate; the precipitates undergo a hydrolytic cleavage. (3) Salts which are already hydrolyzed by themselves do not react quantitatively with metasilicates, either in the cold, or by a small increase of the temperature. More than the theoretical amount of metasilicate is always required to take care of the acidity produced by hydrolysis. Temperature and pressure must be increased to a very large extent to make the reaction quantitative. (*C.A.*)

**The structure of the orthoclase molecule.** O. K. BOTWINKIN. *Z. anorg. allgem. Chem.*, **167**, 190–92 (1927).—The orthoclase molecule is very stable toward $H_2O$ or aqueous solution of $CO_2$. This stability decreases somewhat when the temperature is raised. A pressure increase, even very marked, favors the disintegration of the orthoclase only to an insignificant extent. (*C.A.*)

**Constitution of clay-mud.** H. CHATLEY. *Inst. Civil Eng.*, [52], 3–15 (1927).—The characteristic physical properties of clay as compared with wet sand of similar composition (considerable tensile strength and apparent cohesion, also its impenetrability to water) are the consequence of the fineness of the particles which renders molecular forces important. The properties are best shown when there is a sufficiency of colloid particles to cover and cement the larger ones. Terzaghi's theory of clay structure is discussed. C. has investigated quantitatively the settlement of clay particles from a fresh-water suspension by addition of sea salt, a phenomenon due to the neutralization of the charges on the colloid particles by the adsorption of oppositely charged ions. It was found that sea salt was three times as effective as pure sodium chloride in producing coagulation, this being due to the effect of bivalent calcium and magnesium ions. Alum is more than ten times as effective as salt. There is an optimum concentration of electrolyte for a given colloid concentration, as reversal of the charge takes place with an excess. (*B.C.A.*)

**Determination of boric acid in glass.** A. A. MATSCHIGIN AND T. KORZUCHINA. *Jour. Russ. Phys. Chem. Soc.*, **59**, 573–78 (1927).—The method is based on the precipitation of impurities, *e.g.*, silicic acid and oxides of aluminium, iron, calcium, magnesium, lead, zinc, which hinder the titration of boric acid, by boiling with barium carbonate. The boric acid is thus converted into barium metaborate, which is dissolved in an excess of barium chloride, the excess of carbonate is removed by boiling with 2 *N*-hydrochloric acid, the solution is neutralized with 0–1 *N*-barium hydroxide using methyl orange as indicator, and is then titrated with barium hydroxide in presence of mannitol and phenolphthalein. (*B.C.A.*)

## BOOKS

**Chemical Affinity.** L. J. HUDLESTON. London: Longmans, Green & Co., 1928. Price 7*s.* 6*d.* H.H.S.

**Colloids: A Textbook.** H. R. KRUYT. Translated by H. S. Van Klooster. Pp. xi +262. London: Chapman & Hall, Ltd., 1927. Price 17*s* 6*d.* Reviewed in *Chem. and Ind.*, **47**, 226 (1928).—The book is arranged on this plan: Part I, General introduction; Part II, Suspensoids; Part III, Emulsoids; Part IV, Special cases. H.H.S.

**Microscopic Technology.** (A Textbook for the Microscopic Testing of Materials.) VIKTOR PÖSCHL. Ferd. Enke. Stuttgart, 311 pp. 23.2 RM. (1927); *Tonind. Ztg.*, **51** [96], 1747 (1927). F.P.H.

**Optic and Microscopic Characters of Artificial Minerals.** A. N. WINCHELL. Univ. of Wis., *Studies in Sci.*, No. 4 (1927).—This book is a supplement to Part II of W.'s "Optical Mineralogy." In this work only those minerals are included whose optic properties have been measured on artificial material. The artificial minerals, like the natural minerals, are arranged in accordance with the familiar classification of Dana, modified somewhat in accordance with advancing knowledge and good usage. The following data on the minerals are given: (1) chemical name and composition, usually expressed merely by a formula, (2) crystal system (and axial elements), (3) physical characters including crystal habit, twinning, cleavage, hardness, specific gravity, fusibility, and solubility, (4) optic properties including optic orientation, extinction angles, refringence, birefringence, optic sign, optic angle, dispersion, color, pleochroism and absorption, (5) inversions, (6) synthesis. Determinative tables for the identification of artificial minerals by optical methods are given. F.P.H.

PATENTS

**Process of producing magnesium oxide of high grade.** WILLIAM KOEHLER. U. S. 1,661,043, Feb. 28, 1928. A process of treating magnesium-calcium carbonates, which comprises adding a reagent containing a chloride of the nonalkaline metals to carbonates, calcining the resultant mixture, and removing water-soluble products from the calcined material.

**Purifying mineral substances.** T. W. PARKER AND DARTMOOR CHINA CLAY CO. Brit. 279,694, Dec. 21, 1927. Clay and other minerals containing iron are bleached or decolorized by treatment with acid, with or without a reducing agent, and with aqueous solutions of soluble salts, the bases of which do not form colored compounds with nonchromophoric acid radicals, which are not reducing agents, and of which the acid radicals do not form insoluble iron compounds. Salts of polyvalent metals, particularly salts of aluminium, calcium, barium, or magnesium, or ammonium salts may be employed, while the use of aluminium sulphate, or sodium, potassium, or ammonium alums is particularly advantageous. The salt may be added to the bleaching acid, or to the water used for washing the treated clay, etc., or to both; or it may be mixed with the clay suspension before the latter is treated, formed *in situ* by addition of a metal, its oxide, hydroxide, or carbonate to the bleaching acid, or to the washing water with addition of acid. The water used to wash the treated clay may contain alkali to neutralize any acid remaining therein. (*B.C.A.*)

**Double silicates.** F. SINGER. Brit. 282,402, Feb. 15, 1928. Double silicates, similar in type to naturally-occurring plagioclase compounds, are produced by reacting the oxides, carbonates, sulphates, silicates, or aluminates of divalent metals (such as magnesium, calcium, barium, strontium, zinc, and divalent iron), or mixtures thereof, with alumina and silica at temperatures below the fusion point of the mixture, and preferably at temperatures at least 50°C below the fusion point, the value of the latter being taken as the softening point of the Seger cone. The proportions of the mixture employed may be such as to correspond to the formula $RO \cdot Al_2O_3 \cdot 2SiO_2$. Alumina is preferably introduced as oxide, hydroxide, silicate, double silicate, or aluminate, and silica as quartz sand, alkaline-earth silicate, aluminium silicate, or double silicate. In an example a mixture comprising 10–20 parts magnesium oxide, 33–43 parts alumina, and 40–50 parts silica is reacted at a temperature somewhat above 1000°C. The products are highly resistant to the action of acids, including hydrofluoric acid, and of alkalis, and possess good insulating properties. They may be used for the construction of muffles, filters, or insulators, and as material for stones and abrasives.

**Magnesium from dolomite.** French 616,644; *Rock Prod.*, **31** [3], 77 (1928).—Dolomite is treated with sodium bisulphate to obtain magnesium sulphate which is converted to the oxide by treatment with sodium carbonate and by subsequent calcination of the magnesium carbonate so formed, magnesium oxide results. F.P.H.

## General

**The relative importance of errors of sampling and measurement in ceramic research.** A. E. R. WESTMAN. *Jour. Amer. Ceram. Soc.*, **11** [4], 264–70 (1928).—The common use of average values based on measurements of a small sample of specimens in ceramic research is pointed out. The principal errors to which such averages are subject are described and the need for a method for proportioning sampling errors and errors of measurement shown. An equation giving the relation between sampling errors and errors of measurement is derived by expression of factors involved in statistical terms and combination of well-known statistical equations. This equation is used for constructing a chart by means of which questions involving sampling errors and errors of measurement can be readily solved. This chart also enables one to visualize the rôles played by sampling errors and errors of measurement in determining the accuracy of an average. The general applicability of the method is pointed out and its theoretical limitations are discussed.

**Ceramists' tour abroad.** ANON. *Bull. Amer. Ceram. Soc.*, **7** [3], 50–53 (1928).—A résumé of the life of Josiah Wedgwood, father of English pottery. His productions and work are discussed briefly. The answer to the question, "What is Wedgwood?", is given. E.J.V.

**Bureau of Standards publishes résumé of ceramic investigations.** ANON. *Brick Clay Rec.*, **72** [1], 37–38 (1928).—Progress reports on the following investigations are given: (1) design of hollow tile and brick extruding machines, (2) fundamental properties of fire clay and fireclay products, (3) characteristics of clays used in brick and allied products, (4) boiler furnace refractories, and (5) solid solution in the spinel minerals. E.J.V.

**Hollow Building Tile Association reorganizes.** ANON. *Clay-Worker*, **89** [3], 200–203 (1928); *Brick Clay Rec.*, **72** [4], 252–56 (1928).—A new plan of reorganization which will greatly broaden the scope of the Hollow Building Tile Assn.'s activity was unanimously approved at the convention held in Chicago, Feb. 1–3, 1928. An increase in finances due to increased dues and more tonnage will enable the Association to carry on a program of research, advertising, and engineering promotional work which will undoubtedly effect a tremendous good for the entire hollow tile industry. Addresses delivered during the convention sessions included a strong plea for support of association activities by W. E. Dunwody, retiring president; a remarkable exposition on the needs of the hollow building tile industry, by Edward C. Kerth, chief engineer of the Association; "Advertising as an Aid to Promotion," by I. D. Carson; "Association Advertising," by J. J. Cermak; suggestions on how the manufacturer must face the fact in the present distribution situation, by Alvin E. Dodd, and "Budget Control and Modern Merchandising," by George A. Wilson. E.J.V.

**Common Brick Manufacturers' Assn. annual meeting.** ANON. *Clay-Worker*, **89** [3], 221–26 (1928); *Brick Clay Rec.*, **72** [5], 328–35 (1928).—A report of the 10th annual meeting held at Washington, D. C. Papers read include: "Our Tenth Anniversary," by Wm. Schlake; a keynote address to inspire the manufacturers, by E. Elmo Martin; "The Merchandising of Brick," by R. R. Cunningham; "Direct by Mail Campaign," by Joseph Meadon; "Some New Markets," by Charles A. Bowen; "The Foreign Brick Menace," by Floyd W. Flint; "A United Clay Industry," by B. Mifflin Hood; "When the Brick Man Sees Red," by W. G. Long; "Brickwork in Engineering and Architecture," discussed in papers on "Industrial Research," by G. K. Burgess; "Early Brickwork on the Potomac," by Delos H. Smith; "Bricklayers Supply," by E. L. Bowman; "Physical Properties of Brick Masonry," by L. B. Lent; and "Weather Resistance and the Permanence of Brick Masonry," by J. W. McBurney. E.J.V.

**The Ceramic Society.** ANON. *Pottery Gaz.*, **53** [608], 289–91; [609], 447–51 (1928).—

At the January meeting E. L. Collis presented a paper on "Silicosis." The distinctive characteristics of the disease, early effects, tubercular infection, medical research, and means of prevention were discussed. The February meeting was held at the North Staffordshire Technical College, Stoke-on-Trent. The papers presented were "Possibilities of American Clay for China Making," by C. E. Jackson and "Oil Firing," by Frank West. E.J.V.

**Chimney-gas tests and their significance.** CHAS. F. WADE. *Brit. Clayworker*, **36** [430], 328–30 (1928).—With the exception of such fuel wastes as the excess of combustibles in the ashes, blowing off at safety valves and blow down leakage or excessive blowing down, the largest amount of heat waste takes place via the chimney mainly in the form of sensible heat of the gases and to a lesser extent, in unconsumed combustible gases such as carbon monoxide, methane, hydrogen, and carbon in the form of smoke. The majority of works managers and engineers are even today unprovided with the simplest means of testing their plant with a view of localizing the causes of bad results; some provided with apparatus do not make the fullest use of the potentialities of the instruments, while a very small minority test their plant regularly and are fully acquainted with the best means of applying the gained information. $CO_2$ testing apparatus is often allowed to fall into disuse because by gas analysis alone it is very difficult to ascertain with any degree of certainty what is the cause of a poor percentage of $CO_2$. When such tests are taken in conjunction with temperatures of gases passing up the chimney it becomes an easy matter to determine the cause of troubles. A boiler plant consists of (*a*) heat producing apparatus which is working most efficiently when the fuel is being burned at a high rate per sq. ft. of grate area with minimum possible excess of air and this result is indicated by a high percentage of $CO_2$ in the gases, but no free CO or free carbon (smoke), and (*b*) a boiler which absorbs the heat furnished by the furnace. The more efficient this operates the less heat passes up the stack. Flue-gas tests may be carried out for either of two purposes: (1) to ascertain the efficiency of operation and combustion control; and (2) to maintain observation on the physical state of the boiler and its settings. Testing equipment for both large and small plants are designated. A chart is given covering the temperature, per cent of $CO_2$, water gage reading (draft gage) and test points. The utility of charts obtained depends on the ability of an investigator to interpret them rapidly. The temperature curve or gradient under proper working conditions will fall away from its maximum to the final exit temperature. Factors affecting smoothness of this curve are (1) air leakage, (2) internal short circuits in the gas passages. Relative to $CO_2$ curve, this is of value in distinguishing between faulty firing methods and defective physical condition of the settings. This curve will fall away either gradually or suddenly insofar as the leakage is general or local. The draft curve may be affected by bad brick work if the defects are serious, but is of most value in dealing with firing adjustments and confirmatory evidence in conjunction with the other two curves. A table is given to help interpret the various curves. R.A.H.

**Solubility of limestone in rain water.** ANON. Bur. Stand., *Tech. News Bull.*, No. 130, p. 19 (1928).—Two-inch cubes of limestone are being subjected to weathering tests on the roof of one of the buildings of the Bureau. A discussion of some results is given. R.A.H.

**Physical properties of limestones used for building in the U. S.** D. W. KESSLER AND W. H. SLIGH. Bur. Stand., *Tech. Paper*, No. 349, 97 pp., July (1927).—Physical properties of the limestones used in this country for building purposes are described. Determinations of the strength of these materials in compression, flexures, and shear have been made, as well as a few measurements of tensile strength. Elasticity measurements have been made on the materials in compression and in flexure. Permeability tests on some of the specimens in connection with absorption and porosity tests have

afforded considerable information on the internal structure of the different materials. A series of continuous load tests on specimens in compression and specimens in flexure has given some evidence that these materials are weakened to a slight extent under continual stress. A study of the expansion of limestone for various temperatures up to 300°C indicates a low rate of expansion for the lower temperatures, but the rate increases as the temperatures increase. On lowering the temperature from 300 to 20°C, contraction is less than expansion on heating; *i.e.*, the original length is not reached on cooling. The average coefficient of expansion for several specimens of oölitic limestone measured between 20 and 50°C was found to be 0.000005 per °C. A discussion of the probable effects on the stone facing of steel-frame buildings due to differential expansions is made. Considerable time has been devoted to the study of discolorations on limestone masonry and the relative staining qualities of different limestones. The nature, causes, and effects of efflorescence on limestone masonry has been given consideration. An extensive series of freezing tests has been made to determine the relative resistance of the various materials to frost action. Artificial weathering tests have been studied in this connection but the results of such tests do not appear to be comparable with freezing tests or to afford a reliable indication of weathering qualities. Chemical effects of the elements have been studied mainly by observations on buildings. The limestones from the different quarry regions have been briefly described as to general characteristics. These descriptions have been supplemented by lists of important structures in which the materials have been used. R.A.H.

**New Jersey Clay Workers Association annual meeting.** STAFF REPORT. *Ceram. Age*, **10** [6], 204–208 (1927).—A detailed report of the meeting with abstracts of the papers presented in the technical session. G. H. Brown presented "Notes on the Production of Cream-Colored Bodies." Tests were made to determine the conditions governing the use of rutile and titanium oxide in making vitreous floor tile and hotel china. The conclusions were: (1) rutile is satisfactory in a cream vitreous floor tile body; (2) better colors can be obtained in bodies free from ball clay and low in iron as the color depends upon the proportion of iron and rutile; (3) the use of titanium oxide in place of rutile has possibilities, and when the oxide is used ball clay can be included in the body satisfactorily; (4) the source of rutile is important, its price is not prohibitive and more careful study of proper firing methods is necessary before it can be used commercially as it is sensitive to slight changes in firing conditions. E. C. Henry presented "Effect of Moisture vs. Pressure in the Production of Dust-Pressed Wares." Experiments with a typical electrical body, prepared as in commercial practice, were made. The drying shrinkage, firing shrinkage, and absorption were decreased by increasing the molding pressure. The variation in shrinkage and absorption is less with high pressures or high moisture contents. The drying shrinkage is increased and the absorption decreased by increasing the moisture content. The moisture content determines the maximum density that can be obtained at a given temperature. "Progress Report on Kiln Slab Investigation," by F. B. Allen, discussed the loss of slabs as a straight line function of the number of firings. Aluminous grog tends to give longer life than siliceous grog and slabs containing grog of all sizes last longer than those containing all fine or all coarse particles. A discussion of refractory cements followed. A.E.R.W.

**Practical cost methods for manufacturers of clay products. III and IV.** W. H. COMPTON. *Ceram. Age*, **10** [6], 209–10 (1927).—*Record of productive and nonproductive labor.* It is frequently necessary to keep a record of the labor of each employee in each department. Productive labor contributes directly to the production of ware. Production reports should be prepared periodically. C. lists the information which they should contain. An important item "materials consumed" may be reported (1) as the

number of mixes made during the month, or (2) as the quantity of clay and other materials used during the month. Hints for keeping perpetual inventories of raw materials and for checking them are given. *Fixed charges.* At the beginning of an accounting period a form is prepared indicating the distribution of the fixed charges. C. tells how depreciation, insurance, etc., should be calculated and distributed to the different departments. *Plant survey.* All the records required for successful operation of a cost and general accounting system have been described. The final step is the plant survey during which an endeavor is made to determine the cost unit, *i.e.*, the article job or pieces upon which the final cost is figured. *Ibid.*, **11** [1], 18–20 (1928).—C. shows how letters and numbers can be used in designating departments and accounts as an aid in distributing various items from the books of original entry. A list of numbers and letters which are suggested for use in the books of companies manufacturing clay products is given. Illustrations show a typical floor tile cost card, indicating the rate, unit cost, and quarterly cost; and a typical wall tile cost card giving similar information. For I and II see *Ceram. Abs.*, **7** [2], 78 (1928). A.E.R.W.

**U. S. Potters' Association holds annual meeting.** STAFF REPORT. *Ceram. Age*, **10** [6], 211–13 (1927).—Labor costs, market conditions, importations of ware from other countries and the tariff were discussed. The latest tendencies in color and design were pointed out. The trend of sales, importations, and retail prices were analyzed in detail. A.E.R.W.

**Large building volume to continue through 1928.** C. S. TAYLOR. *Ceram. Age*, **11** [1], 22–24 (1928).—The building records of the year 1927 indicate that construction activity has continued at a pace almost equal to that of the record-breaking year of 1926, the total annual building volume being well over seven billion dollars. Figures based on the survey of *The Architectural Forum* which was carried out indicate that building will continue in 1928 at least in the same volume as that in 1927, if not in greater volume. Increased building requirements coupled with national prosperity, replacement of obsolescent and burned buildings, the natural growth in the population, and increased standards of living can account for the large volume of business in recent years without considering that a boom has been in progress. A detailed analysis of the forecast, illustrated with tables and charts is given. A.E.R.W.

**Works and activities of the technical service during 1926.** VICTOR BODIN. *La Ceramique*, **30** [469], 49–51 (1927).—A report of the director of the technical service of the Syndicat des Fabricants de Produits de France. Sixty-one kilns and driers were examined during 1926. The results obtained are shown by excerpts from 6 letters from the companies concerned. Contracts for 14 periodical visits to 26 installations during 1927 were secured. All the contracts for 1926 were continued into 1927. Ceramic information was distributed and an exposition was held. Methodical researches on drying, necessarily time-consuming are being carried out. Courses of improvement for foremen, head burners, and workmen have been arranged. A.E.R.W.

**Opening and curriculum of courses of L'Ecole de Paris.** ANON. *La Ceramique*, **30** [469], 52–54 (1927).—A description of courses in ceramic technology for engineers, plant managers, foremen, and workers. A.E.R.W.

**The measurement of air quantities and energy losses in mine entries. II.** A. C. CALLEN AND C. M. SMITH. Univ. of Ill., Eng. Expt. Sta., *Bull.*, No. 170. A.E.R.W.

**The functions of research.** CHARLES F. KETTERING. *Ind. Eng. Chem.*, **19** [11], 1212–16 (1927).—A review of the many-sided functions of research as seen by the director of research for the General Motors Corporation. Among those discussed are (1) the interpretation of science to the public, (2) the determination of facts, (3) selling ideas, (4) translation of technical details into results, and (5) remedying troubles. R.J.P.

**Research, the enemy of stability.** C. E. K. MEES. *Ind. Eng. Chem.*, **19** [11], 1217–19 (1927).—It is pointed out that research has caused business to hesitate in financing industries based on chemical engineering because in a short time a new method may be evolved and the former method become obsolete. As a solution for this condition it is suggested that large organizations be formed which can easily absorb such changes. R.J.P.

**Developments in steam generation.** GEORGE T. LADD. *Blast Fur. Steel Plant*, **16** [2], 266–69 (1928).—A review of the progress made in the methods and apparatus for generating steam is given. High steam pressures, air preheating, and fuels are discussed. F.P.H.

**Power and heating needs in power plants.** C. L. HUBBARD. *Blast Fur. Steel Plant*, **16** [2], 270–73 (1928).—The question of whether it is more economical to purchase power or to generate it in the plant is discussed. F.P.H.

**Ceramics in England.** ANON. *Ceram. Ind.*, **10** [3], 314 (1928).—The leading banks of the United Kingdom have now held their annual meetings and the respective presidents have issued their views with regard to the future of industry in the country. The pronouncement of the "Big Five" to the effect that 1927 saw the turning point in the deep-seated depression that has overhung Britain since 1920, is received with considerable satisfaction. F.P.H.

**Sand setting and devices for settling and classifying sand. I.** EDMUND SHAW. *Rock Prod.*, **31** [3], 37–40 (1928).—Principles of setting and classifying are discussed. F.P.H.

**Progress in research and technology of rock products in 1927.** ANON. *Rock Prod.*, **31** [3], 52–56 (1928).—A summary is given of abstracts and scientific papers published during 1927. The following subjects are covered: (1) composition of cement, (2) clinker composition, (3) hydration and hardening, (4) physical and chemical analysis, (5) cement patents, (6) unsintered hydraulic cements, (7) improved cement kilns, (8) lime, (9) plastic hydrates, (10) quick-setting limes, (11) gypsum research, (12) cellular cement, (13) magnesia and magnesia cements, (14) rock phosphates, (15) sand-lime brick, (16) potash and feldspar, (17) slate, mica, and fluorspar, (18) aggregates. F.P.H.

**Sand-Lime Brick Association meeting.** ANON. *Rock Prod.*, **31** [4], 85–89 (1928).—Report of the 24th annual meeting of the Sand-Lime Brick Association at Washington, D. C., is given. F.P.H.

**International Congress for Testing Materials.** HANS HECHT. *Tonind. Ztg.*, **51** [83], 1507–10 (1927).—A few of the papers abstracted are: (1) "Experience with Cement in Sea Water," by Grün; (2) "The Test Methods for Portland Cement according to Various Standard Procedures," by Haegermann; (3) "The Present State of the Standard Tests for Portland Cement," by M. Ros; (4) "Methods of Testing Road Building Rock," by Burchartz; (5) "The Testing of Building Brick in Compression," by Burchartz. F.P.H.

**Economy of various methods of loading coal in railroad cars.** CARL WEICKEN. *Tonind. Ztg.*, **51** [84], 1527–30 (1927). F.P.H.

**Electrical power in tile works.** CARL COBLENZER. *Tonind. Ztg.*, **51** [89], 1616–18 (1927).—A comparison is made of the cost of using the following types of power in a tile works: (1) steam power with condensation, (2) steam power without condensation, (3) electric motors, (4) Diesel motors. F.P.H.

**Strass as a building material.** H. BURCHARTZ. *Tonind. Ztg.*, **51** [91], 1658–60 (1927). F.P.H.

**Suitable accounting in a lime and marl plant.** OTTO PICKLER. *Tonind. Ztg.*, **51** [92], 1681–84 (1927). F.P.H.

**Data on belting.** ART HERSKE. *Abrasive Ind.*, **9** [3], 90 (1928); *Electrical Prod. Mag.*—Narrow belts over small pulleys, averaging 15 ft. on centers, should have a sag on the loose side (preferably on the upper side of the belt) of $1^1/_2$–2 in. Medium width belts running over larger pulleys averaging 25 ft. on centers should have a sag of $2^1/_2$–4 in. on the loose side. Main belts for very large pulleys, averaging 25 to 30 ft. on centers, should have a sag of 4–5 in. on the loose side. If possible, the lower side should be the driving side in order to increase the arc of contact by the sag in the upper side of the belt. The slope of the belt over horizontal should not exceed 45°. The lapped joint on the belt should always trail over the pulley. The grain side of the belt should be placed against the pulley in order to obtain 30% additional strength for the belt. To find the power of a belt use: H.P. $= \frac{VW}{1000}$, for single belts; H.P. $= \frac{VW}{700}$, for double belts; to find the length $\frac{(D+d)\ \text{II}}{2} + 2C$; and to find the approximate belt speed: $\frac{D}{4} \times$ r.p.m. = speed in feet per min. where $V$ = velocity in feet per min.; $W$ = width of belt in inches; $D$ = diameter in inches of larger pulley; $d$ = diameter in inches of smaller pulley; and $C$ = distance between centers of pulleys in inches. P.F.C.

**Jobber's position upheld.** FRANK FARRINGTON. *Pottery, Glass and Brass Salesman*, **37** [2], 13 (1928).—The jobber is essential in the trade; (1) makes it possible for the dealer to turn his stock quickly; (2) maintains a central warehouse; (3) gives to the retailer only one account; (4) a central source of all adjustments, as to errors in quantity, quality, etc.; (5) extends credit to the dealer and helps him to carry his business past the dull periods; (6) makes it possible for the dealer to carry a more varied line of ware; (7) makes it possible for the retailer to keep his stock in fairly complete form even when transportation is slow; (8) makes it a simple matter for the dealer to establish a credit with his source of supplies; (9) makes it possible for the manufacturer to distribute his product quickly and cheaply throughout the country without the heavy expense of covering the whole territory himself; (10) brings the guarantee of a thousand products near enough to the dealer to be understood and trusted by him. With the jobbers eliminated, net profits would be reduced almost to the vanishing point, save for the very large stores. P.F.C.

**Apprenticeship and training in the British pottery and glass industries.** ANON. *Chem. and Ind.*, **47**, 153–54 (1928).—The Ministry of Labor has issued a report on apprenticeship and training for skilled occupations. It is the third of a series of seven and covers (1) mining and quarrying, (2) metal extraction, (3) chemical glass, (4) pottery, and (5) allied industries. In glass manufacture, 46% of the male workers are classed as skilled, and apprenticeship is a common method of training, the period being usually 5 years. In pottery manufacture also, apprenticeship is the usual method of entering the skilled occupations, but in the clay industries there is a high proportion of unskilled laborers, and apprenticeship is practically nonexistent. H.H.S.

**Dividends from research.** L. V. REDMAN. *Chem. and Ind.*, **47**, 162 (1928).—A lag of about 8 years and an expenditure 10 times the cost of the laboratory research intervene between the initiation of a research and its first payment of dividends. H.H.S.

**Technical education in Quebec.** A. FRIGON. *Indus. Can.*, **28**, 82 (1928).—Students admitted to technical schools must be indented apprentices to some trade, and the number of students admitted is limited strictly to the need of the trade. The advisory committee consists of representatives from both employers and employees of the trade concerned. H.H.S.

**The function of Section M (engineering).** C. R. RICHARDS. *Science*, **67**, 5–7 (1928).—R. outlines the growth of a professional consciousness among American engineers. The A.S.C.E. was organized in 1852, the Mining Engr., in 1871, the Mech. Engr., in 1880, and Elec. Engr., in 1884; these are the "founder societies." Section D (mechanical science), Amer. Assn. Adv. Sci., was organized in 1881, and in 1919, when the new constitution was adopted, the old section became section M (engineering). Its function, as defined by R., is to establish a bond between engineers and scientists, so that the former will become more scientific, and the latter more practical. H.H.S.

**Eugene Allen Smith obituary.** W. B. JONES. *Science*, **67**, 7–9 (1928).—Born at Washington, Ala., Oct. 27, 1841, S. was educated at the Univ. of Alabama and, after the Civil War, in Germany. He returned to America in 1868 and became assistant professor at the Univ. of Mississippi. Three years later he was elected professor of chemistry and mineralogy at Univ. of Alabama, and in 1873 was appointed State Geologist of Ala., which post he held until his death on Sept. 7, 1927. The development of the coal, cement, and mineral industries of his State is largely due to him. H.H.S.

**Bernard Palissy, Huguenot potter.** GRACE M. ZIEGLER. *Sci. Monthly*, **26**, 28–33 (1928).—Although the name of Palissy (1509–1589) is chiefly associated with his pottery, which commands excessive prices, he was an outstanding naturalist of his century. From a study of clays he turned to soils, potashes, and their influence on crops, thence to his discourse on "how to grow rich in farming," and to his writings on forestry, geology, and chemistry. He became "workman in earth to his majesty," and in his own museum at Paris delivered over a period of 9 years the first lectures on natural history ever given in that city. H.H.S.

**Where the mechanical stoker stands today.** H. D. FISHER. *Combustion*, **18** [3], 173 (1928).—Various types of stokers which are classified, the conditions under which they are most useful, and the place of the stoker in the scheme of the modern power plant are discussed. G.W.W.

**Utilization of the earth's internal heat.** JOHN L. HODGSON. *Combustion*, **18** [3], 187 (1928).—A review of a paper read before the British Assn. Advancement of Sci., and deals with the possibility of economically utilizing the earth's internal heat. (Reviewed by E. K. Scott.) G.W.W.

**The growing importance of coal as a raw product.** T. S. BAKER. *Combustion*, **18** [3], 191 (1928).—Coal can no longer be regarded as a fuel alone but as a raw product which can be turned into a variety of commodities. The necessity of getting more out of coal with the idea of increasing its value without raising its cost is stressed. An international conference will be held at the Carnegie Institute of Technology in Nov., 1928, at which it is expected that many discoveries of great importance will be announced. G.W.W.

**Combustion in Germany.** ANON. *Combustion*, **18** [3], 194 (1928).—Two new types of powdered fuel locomotives have given satisfaction so far. Lower fuel costs, independence of kind and blend of coal, increased efficiency, reduced initial time for making steam, high adaptability to varying loads and overloads, absence of smoke and sparks, removal of strain on the fireman and good overall economy are listed as the advantages. The use of pulverized fuel is described briefly, principally the subdivision of the stream of fuel into a very great number of small jets. The calorific load reaches the so far unheard of figure of 250,000 B.t.u. per cu. ft. an hr. This fact opens the definite possibility of confining powdered fuel flames in small spaces and enlarges the scope of the application of powdered fuel combustion. G.W.W.

**Mechanical stokers.** ANON. *Combustion*, **18** [3], 195 (1928).—An editorial in defense of automatic stokers, because of the lack of standardization in the newer equipment for pulverized coal and for oil burners. G.W.W.

**A useful line for fuel research.** J. W. COBB. *Engineer*, **144** [3745], 458 (1928).—Editorial comment on a paper on "The Utilization of Our Coal Supplies," by C. who suggests that in the conversion of raw coal into smokeless fuel, chemical reaction rather than changes in the mechanical or thermal treatment will improve the quality of the products and is therefore worth investigation. In the laboratory 5% oxide of iron and soda materially influence the process of carbonization and give finer grained, more homogeneous, and stronger coke, but did not give the same results when tried on a large scale, but the gas yield was increased 20%. When calcium carbonate was the catalyst the ammonia yield was increased 35%. The cokes were given extraordinary properties by the catalysts; *e.g.*, they can be turned into water gas at 9 or 10 times the rate of ordinary coke. Data are given to show their behavior. If the reactions are due to true catalysts the cost is small if the catalysts can be used again. The immediate need seems to be to find out how to do commercially what the laboratory shows to be possible. G.W.W.

**Unit mill fired boilers at Cahokia Station.** TENNY. *Power*, **67** [5], 178 (1928).—Using two 15,000-pound mills per boiler of 18,010 sq. ft., sustained boiler ratings up to 400% are possible. Efficiencies at all ratings are good, slagging in the ash pit has been eliminated and the mills, so far, have proved entirely satisfactory. The burners are the horizontal turbulence type. A table gives a summary of the test runs with unit mills. Pictures show: coal weighing equipment, water-cooled side wall view, water measuring apparatus, boiler operating board and controls, front wall and furnace, cross-section through boiler and furnace, improved burner design, and the unit mills located on the basement floor. G.W.W.

**Waste heat power for modern cement mill.** SMITH. *Power*, **67** [5], 187 (1928).—In a 3000-bbl. plant of the Dewey Portland Cement Co. at Davenport, Ia., waste heat from powdered coal-fired kilns generates sufficient steam to meet power demands with condensing turbine generators. Boilers are equipped with superheaters and economizers. The heat-balance is maintained by an evaporator system arranged to use all surplus steam for the making of distilled water which is stored for boiler feed. Hand-fired boiler and noncondensing house turbine provide power for starting or stand-by service when the kilns are shut down. Pictures show: (1) feed end of kiln, (2) the 2 waste heat boilers, (3) the rotary kilns from the firing end and turbine room. Diagrams show plan and elevation through the power plant and typical heat-balance for normal load, indicating schematically the system operation. The installation has been successful and has fully demonstrated its flexibility, reliability, and economy in operation under varying conditions. G.W.W.

**Safety in working conditions.** PARKER. *Power*, **67** [5], 193 (1928).—The law requires the employer to supply a reasonably safe place and tools for his employees. Employers may reduce the chances of liabilities by inspecting equipment at regular intervals and repair defective tools and equipment immediately. G.W.W.

**Plant engineer, his duties, responsibilities, and relations with other departments.** ANON. *Power*, **67** [5], 219 (1928).—Chart I illustrates the outline for an individual manufacturing plant, and Chart II gives an organization plan for a larger manufacturing plant with factories located in different cities, but controlled from a central office. A function chart shows the details of the activities of the plant engineering department. This chart should be used as a guide in developping an organization for a plant engineering department, the duties of which are outlined in the foregoing discussion. G.W.W.

**Advances in ceramics in 1926.** M. MIELDS. *Chem.-Ztg.*, **51**, No. 93; *Fortschrittsber.*, 112–18 (1927). (*C.A.*)

BOOKS

**Archaeology of Ireland.** R. A. S. MACALISTER. London: Methuen & Co., 1928. Price 16*s.*—M. is professor of Celtic Archaeology in University College, Dublin H.H.S.

**Building Science Abstracts.** London: H. M. Stationery Office, 1928. (Price 10 pence monthly, or 10*s* post free annually.) A new monthly publication on the science and practice of building. The abstracts are classified under the following headings: stone, mineral earths, clay and ceramics; lime, plaster, and chemical compositions in general; cement and concrete; metal, organic building materials; paint and varnish; materials in general, their properties and testing; elements of structures; housing and domestic engineering; specialized construction. (Reviewed in *Chem. and Ind.*, **47**, 222 (1928).) H.H.S.

**Ceramic Practice.** AUGUST BERGE. 2nd ed. 92 pp. (1927). Wilh. Knapp. Halle A. S. *Tonind Ztg.*, **51** [91], 1665 (1927). F.P.H.

**Opinions of Professional Engineers Concerning Educational Policies and Practices.** A Summary of Inquiries by the A.S.C.E., A.I.M.M.E., A.S.M.E., and A.I.E.E. The Lancaster Press, Lancaster, Pa. 61 pp. 30 cts. *Min. and Met.*, **9** [255], 162 (1928). F.P.H.

## Book Reviews

**Journal of the Institute of Metals.** Vol. 38, 813 pp., 59 plates and illus. Edited by G. Shaw Scott, 1927. London. Price 31*s* 6*d*. This volume contains fourteen original papers of practical metallurgical interest. More than one-half the volume is devoted to abstracts on metallurgy. The volume should prove helpful to every metallurgist and engineer who is interested in the technical literature on this subject.

**Early American Glass.** RHEA MANSFIELD KNITTLE. *Amer. Glass Rev.*, **47** [23], 15–16 (1928).—The first provincial glass furnace was erected at Jamestown in Virginia. The locations of the various furnaces, their sizes, construction, ownership, fuel problems, etc., are discussed over the ensuing 256 years, up to the time of the introduction of the Leighton process in 1864. The various types of early American glassware, the diversity of patterns and molds, and the technique of the designers and blowers are described. A diversity of products was found in the same factory in contrast to that of today where only one product is made. No identification, as trade mark, was employed by early manufacturers. Glass industries grew, prospered, and failed and then disappeared, and today even those towns in which they were located have no recollection or trace of them. The biggest boon, prior to recent years, was in the period of 1810 to 1840. The glass factory followed until the industry became stabilized in the Pittsburgh and Ohio Valley. Since then there has been a constant spreading of the industry but at no time has it been so marked as that of 100 years ago. American glassware always has had designs of its own in texture, form, and decorations. The makers were not base copyists and attempted to evolve a technic and form of their own. The growth of the industry from the first 2 plants at Jamestown, the men responsible for this expansion, the location of all of the prominent plants, their officials, problems, and products manufactured are described. P.F.C.

Following numbers of the *Journal* and *Transactions of the American Ceramic Society* are out of print:

*Journal of the American Ceramic Society*

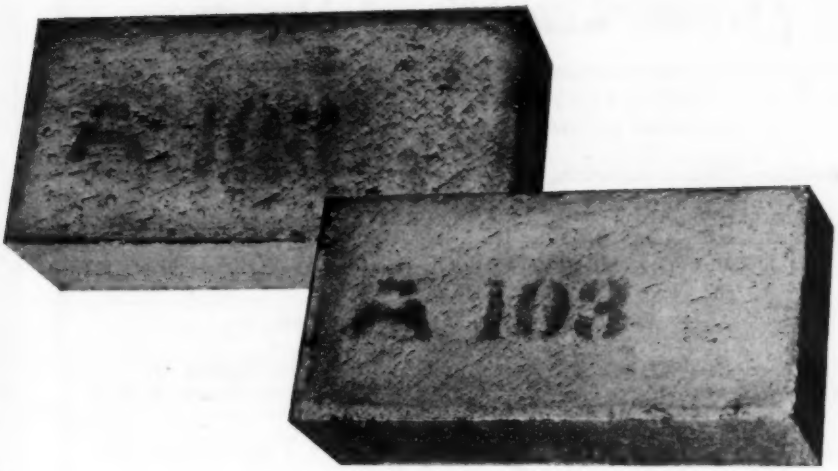
June, 1923
January, 1924
February, 1924
January, 1925
January, 1926
March, 1927
January, 1928

*Transactions of the American Ceramic Society*

Volume II, 1900
Volume IV, 1902
Volume V, 1903
Volume VI, 1904
Volume VII, 1905
Volume VIII, 1906
Volume IX, 1907
Volume X, 1908
Volume XI, 1909
Volume XII, 1910
Volume XIV, 1912
Volume XV, 1913
Volume XVI, 1914
Volume XVII, 1915
Volume XVIII, 1916
Volume XIX, 1917

It is necessary that the SOCIETY secure copies of these publications and will pay $1.00 for *Journals* and $5.00 for *Transactions* sent to this office.

2525 North High Street
COLUMBUS, OHIO



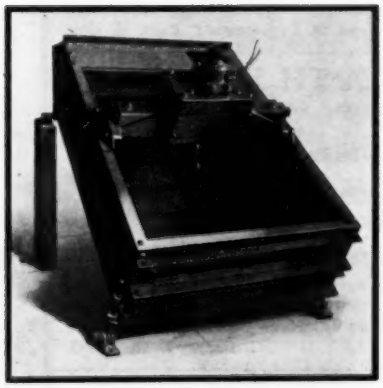

# Which One?

ONE of these bricks was made with the Hummer Electric Screen Process.

Both were made at the same plant from the same material —the brick made with Hummer screened clay cost less!

Let us show you how to make better brick at lower cost.

Write for further information!



THE W. S. TYLER COMPANY
*Cleveland, Ohio*
Manufacturers of Woven Wire Screen and Screening Equipment

**HUM-MER *Electric* SCREEN**

*(When writing to advertisers, please mention the JOURNAL)*

# *Ceramic Educational Directory*

## THE OHIO STATE UNIVERSITY

*Department of Ceramic Engineering* COLUMBUS, OHIO

*Founded 1895*

*Curriculum*—Ceramic engineering and technology. Advanced research in cooperation with State owned plants and Federal Government.

*SIX INSTRUCTORS* *Head of Department:* ARTHUR S. WATTS

## NEW YORK STATE SCHOOL OF CLAY-WORKING AND CERAMICS

ALFRED UNIVERSITY, ALFRED, NEW YORK

*Founded 1900*

*Curriculum*—Ceramic Engineering, Ceramic Chemistry, Applied Art

*SEVEN INSTRUCTORS* *Director:* CHARLES F. BINNS

## RUTGERS UNIVERSITY

NEW BRUNSWICK, N. J.

*Ceramic Department founded 1902*

*Curriculum*—Ceramic Technology and Engineering

*THREE INSTRUCTORS* *Director:* GEORGE H. BROWN

## UNIVERSITY OF ILLINOIS

*Department of Ceramic Engineering* URBANA, ILLINOIS

*Founded 1905*

*Curriculum*—Ceramic Engineering and Ceramics, the latter is a non-engineering course in the technology of ceramic products.

*SIX INSTRUCTORS and a research associate* *Head of Department:* C. W. PARMELEE

## IOWA STATE COLLEGE

*Department of Ceramic Engineering,* AMES, IOWA

*Founded 1906*

*Curriculum*—Ceramic Engineering major, Ceramic Technology and Pottery subordinate.

*THREE INSTRUCTORS* *Head of Department:* PAUL E. COX

## THE UNIVERSITY OF NORTH DAKOTA

*Department of Ceramics and Ceramic Engineering,* GRAND FORKS, N. D.

*Founded 1910*

*Curriculum*—Ceramic Art and Technology

*FIVE INSTRUCTORS* *Director:* A. W. GAUGER

## UNIVERSITY OF WASHINGTON

*Department of Ceramic Engineering* SEATTLE, WASHINGTON

*Founded 1918*

*Curriculum*—General ceramic engineering with research in ceramics and non-metallics.

*Coöperation with the U. S. Bureau of Mines*

*Director:* HEWITT WILSON *Assistant:* J. H. YATES

## UNIVERSITY OF SASKATCHEWAN

SASKATOON, SASK.

*Founded 1921*

*Curriculum*—Ceramic Engineering

*TWO INSTRUCTORS* *Head of Department:* W. G. WORCESTER

## PENNSYLVANIA STATE COLLEGE

*Department of Ceramics, School of Mines and Metallurgy*

STATE COLLEGE, PENNA.

*Founded 1923*

*Curriculum*—Ceramic Engineering

*Head of Department:* J. B. SHAW *Instructor:* GEO. J. BAIR

## GEORGIA SCHOOL OF TECHNOLOGY

ATLANTA, GEORGIA

CERAMIC DEPARTMENT

*Founded 1923*

*Curriculum*—Ceramic Technology and Engineering

*TWO INSTRUCTORS* *Director:* A. V. HENRY

## NORTH CAROLINA STATE COLLEGE OF AGRICULTURE & ENGINEERING

RALEIGH, NORTH CAROLINA

*Department of Ceramic Engineering founded 1923*

*Curriculum*—Ceramic Engineering

*TWO INSTRUCTORS* *Head of Department:* A. F. GREAVES-WALKER

## WEST VIRGINIA UNIVERSITY

MORGANTOWN, W. VA.

*Ceramic option course founded 1924*

*Curriculum*—students selection of ceramics includes chemical and engineering principles applied to ceramic manufacture.

*TWO INSTRUCTORS AND TWO ASSISTANTS* *Director:* W. A. KOEHLER

## UNIVERSITY OF TORONTO

TORONTO, CANADA

*Founded: University, 1827. Department of Metallurgy, Ceramic Division, 1925.*

*Curriculum*—Ceramic Engineering and Technology

*TWO INSTRUCTORS* *Principal Instructor:* ROBERT J. MONTGOMERY

## MISSOURI SCHOOL OF MINES & METALLURGY

OF THE UNIVERSITY OF MISSOURI, ROLLA, MO.

*Founded 1926*

*Curriculum*—Ceramic Technology and Ceramic Engineering

*TWO INSTRUCTORS*

*Director:* CHAS. H. FULTON *Head of Department:* M. E. HOLMES

## LOUISIANA STATE UNIVERSITY

BATON ROUGE, LA.

*Ceramic Department founded 1926*

*Curriculum*—Ceramic Engineering

*Head of Department:* J. W. WHITTEMORE

## THE OHIO STATE UNIVERSITY

*Department of Fine Arts* COLUMBUS, OHIO

*Founded 1927*

*Curriculum*—ceramic art and technology to train artists for the ceramic industries.

*THIRTEEN INSTRUCTORS* *Head of Department:* JAMES R. HOPKINS

# *For Ivory Cream and Buff Colors*

IN the increasing demand for colors in ceramic wares, the trend of favor is for the soft-toned ivories, creams and buffs.

Beautiful effects can be obtained by the addition of titanium compounds to the regular white frit batch for glazes and enamels, and to the raw batch for vitreous bodies.

Quick delivery can be made of any of the following standard grades of Rutile, or of chemically pure Titanium Oxide.

TAM RUTILE

**TAM RUTILE GRANULAR.** The natural Florida mineral highly concentrated by our magnetic and electro-static process; approximately one hundred mesh fineness.

**TAM RUTILE DARK TONE MILLED.** A two hundred mesh grinding of the granular product.

**TAM RUTILE LIGHT TONE MILLED.** A finely milled product, original with us, especially suitable where bright tones and strict uniformity of shade are required.

**The Titanium Alloy Manufacturing Company**

WORKS AT NIAGARA FALLS, N. Y.

*Ceramic Materials Division:* R. D. Landrum, General Manager

6007 Eucide Avenue, Cleveland, Ohio

# BULLETIN
of the
## AMERICAN CERAMIC SOCIETY

**A Monthly Publication Devoted to Proceedings of the Society, Discussions of Plant Problems, Discussions of Technical, Scientific, and Art Questions and Promotion of Coöperative Research**

Edited by the Secretary of the Society Assisted by Officers of the Industrial Divisions

| | | | | | |
|---|---|---|---|---|---|
| E. DEF. CURTIS, MARION FOSDICK, H. G. WOLFRAM, W. N. HARRISON | Art, Enamel | C. D. SPENCER, G. W. COOPER, L. J. TROSTEL, C. F. GEIGER, H. P. HUMPHREYS, R. F. SHERWOOD | Glass, Refractories, White Wares | H. E. DAVIS, F. S. SCHEPERS, C. A. NICELY, G. A. BOLE | Terra Cotta, Heavy Clay Products |



OFFICERS OF THE SOCIETY
M. C. BOOZE, President
Chas. Taylor Sons Co., Cincinnati, Ohio
R. R. DANIELSON, Vice President
Metal and Thermit Corp., New York, N. Y.
H. B. HENDERSON, Treasurer
Standard Pyrometric Cone Co.
1538 N. High St., Columbus, Ohio
ROSS C. PURDY, General Secretary and Editor
EMILY C. VANSCHOICK, Assistant Editor
2525 N. High St., Columbus, Ohio

TRUSTEES
B. MIFFLIN HOOD
R. L. CLARE
B. T. SWEELY
J. C. HOSTETTER
G. W. DENISON
F. A. HARVEY
A. V. BLEININGER
E. DEF. CURTIS



**Vol. 7** **May, 1928** **No. 5**


# EDITORIALS

## SOCIETY CONSCIOUSNESS

We believe in individualism. Each person should acquire and conserve all available resources: material, social, spiritual, and intellectual for self-development and position. Selfishness is laudable and on it depends all the concerted enterprises of men.

And among the most valuable resources for self-improvement and advancement is coöperation one with another.

Our success as well as our advancement is dependent quite largely on obtaining the coöperation of our fellows. For this purpose there are organizations and there are federations of organizations: government, schools, churches, business firms, etc., which are dependent on being organized and manned effectively.

And the success of these organizations depends in turn on individuals. No organization can succeed unless its members individually are kept to maximum of effort in (1) self-development, (2) coöperation, and (3) directing the efforts of both to best development in the mutual objective of both.

The individual who is not whole-heartedly and constantly striving to make the most for himself and his associates is not true either to himself or to his associates.

One of the essentials to individual and collective enterprises is constant thinking, planning, and working to make each successful,

and acquiring the largest possible resources for each. Thinking only for one's self is self-defeating.

The collective enterprise of promoting the ceramic arts and sciences, for which enterprise individuals are collaborating and for which they maintain the organization known as the AMERICAN CERAMIC SOCIETY, is no exception. The success of this SOCIETY in the objective for which the members are associated will be small or large according to the amount of thought and service given by its individual members.

The officers and committeemen devise the means for the members to serve but the individual members must accomplish this service. It is not that this particular SOCIETY shall succeed but that the benefits in known facts recorded and correlated for industrial application shall be secured.

And if this is not the most effective means for collectively securing and individually converting to factory practice the large fund of information which is being made available it is because this SOCIETY has failed in enlarging the vision of the individual members to the value of coöperation.

In the last analysis each member will obtain an increase in knowledge from this coöperative enterprise in proportion to the effort which he individually puts forth to make the collective effort more productive.

Individualism is necessary. Collectivism is essential. But the danger in collectivism lies in the individuals forgetting that only when these collective efforts come intensely and wholly from themselves and for them can these efforts be most profitable.

---

## CERAMIC LIBRARY AND MUSEUM

A ceramic library and museum that would truly reflect the knowledge and resourcefulness of American ceramists would take much money and a great deal of labor to collect and to keep in workable shape. And too, what would such a library and museum accomplish?

Rather than a national ceramic library and museum it would seem to be much more practical for the colleges, municipalities and the museums to collect and make available in the different sections of the country such literature and ceramic objects as are of most benefit to the industries in each district.

This SOCIETY can promote a consciousness of the industrial values in ceramic libraries and museums and perhaps can most effectively promote this consciousness by having a good library and museum at its headquarters.

The compiling of bibliographies naturally is one of the rightful tasks on which the SOCIETY constantly should be engaged.

And the collecting of the histories of ceramic progress with photographs of those who have achieved leadership in ceramic concerns and associations is another legitimate task of this SOCIETY. If the individual members believe these to be a proper enterprise of the SOCIETY they may record their beliefs by sending to the headquarters of the SOCIETY the photographs and personal histories of themselves and business associates and also the histories and photographs of their manufacturing plants.

# PAPERS AND DISCUSSIONS

## PRACTICAL AIDS TO WET PROCESS CAST-IRON ENAMELING[1]

By J. E. Hansen

ABSTRACT

The importance of design of castings and proper foundry practice is discussed, together with the advantages of the proper type of "filler" for holes in porous castings. The functions and advantages of a ground-coat enamel are discussed, and the effect of the time-temperature comeback of the enameling furnace is shown to be important toward getting best results. Multiple-deck firing aids in obtaining a slower comeback and increases production.

### Introduction

The enameling of cast iron by the wet process has now been developed to such a stage in the many plants throughout this continent that it may be considered a stabilized industry, undoubtedly still in the process of improvement, but out of the experimental stage.

There are, however, many points which may properly be called to the attention of the industry, which aid in greater production, a higher quality of ware, less trouble in the processing, and a minimum amount of defective ware. It is the purpose of this paper to discuss a few of these points, some of which may perhaps have been mentioned in the literature, but to which too much attention cannot be paid.

### Design of Castings

Within reasonable limits, almost any type of gray-iron casting can be enameled successfully by the wet process, but for a large scale production basis, the task of the enameler is far easier if proper attention is given to the design of the various castings.

The castings should be of as even cross-section as possible. Extremely thin sections should be avoided, for they are difficult to enamel, and may cause cracks or warpage in the casting. Sharp edges and corners should be eliminated wherever possible, not only because of the difficulty of applying enamel on these sharp contours and holding it there during the firing process, but also to minimize chippage on finished ware. Extremely heavy sections such as lugs or reinforcing ribs should be eliminated if the casting can be properly designed without them, and in any event, they should be cut down to a minimum thickness.

### Foundry Practice

The patterns from which the castings are made should preferably be run with the face down in the drag. In this way, the face to be

[1] Presented at the Annual Meeting, American Ceramic Society, Atlantic City, N. J., February 1928. (Enamel Division.)

enameled is down when the hot metal is poured, and any dirt or slag is carried to the top or back side of the casting where it can do little or no damage.

All forms of foundry facings such as plumbago, charcoal, sea coal or other varieties of mold facings, should absolutely be avoided on castings that are to be enameled. These facings burn into the hot iron and impregnate it with carbonaceous material which burns out in the enameling process, causing blisters or pinholes in the enamel.

The gates should be on the edge and not on the face of the casting. Each gate should be as liberal in length along the casting as is practical, and two or more gates to the piece should be used wherever possible, in order to fill the mold rapidly with hot metal. For large castings, wherever foundry practice will permit it, "skimmer gates" should be employed to strain out or skim out much of the dirt and slag which otherwise may find its way into the body of the casting. Proper distribution of the gates along the casting often has an important effect with regard to warpage both before and during the enameling process.

As an aid to getting hot metal into the castings to be enameled, it is well to set up the molds near the cupola, especially all large but light parts.

Castings to be enameled should be shaken out as soon as possible, as they seem to draw a certain amount of moisture from the damp sand, which sometimes causes trouble in the enameling process.

Cast iron of an analysis within the following limits usually gives quite satisfactory results, although it is to be admitted that the proper analysis without other proper foundry practices is of little help:

| | |
|---|---|
| Silicon | 2.50–3.00% |
| Manganese | .45– .60 |
| Sulphur | .05– .09 |
| Phosphorous | .60– .70 |

The Bureau of Standards has for several years been investigating cast iron for enameling purposes.

### Filler for Porous Castings

Regardless of the refinements used in design of castings and in foundry practice, the enameler is certain to find imperfect castings reaching his department, containing slag holes, gas pockets, and other defects. Such imperfections, if not too large, should be properly "plugged" with a suitable filler, for it should be remembered that the enamel will follow the surface of the iron and carry any casting defect through to the finished surface.

The proper filler is a porcelainlike mixture which will vitrify at the

enameling temperature, and which will expand and completely fill the cavity. The compound must be worked down to the bottom of the hole to insure the elimination of any entrapped air, which, if present, will expand in the firing process and displace the filler.

The use of a filling compound will not make up for all the shortcomings of poor castings, but it is a useful aid toward production of high quality.

### Use of Ground-Coat Enamels

It is common practice in wet-process cast-iron enameling to use the same enamel for first and finish coats, thus differing from sheet-iron practice, where a ground-coat enamel is used directly on the metal, and an enamel of different composition used for a cover or finish coat. The enameler of cast iron may also use a ground coat, and thereby obtain advantages or qualities in the finish enamel which could not otherwise be imparted thereto.

It is oftentimes impossible to incorporate into an enamel applied directly on the iron certain qualities of appearance and corrosion resistance, because the quality-giving constituents do not act favorably in that particular combination with the metal upon which they are applied. Under such circumstances, it is advisable to use a cast-iron ground-coat enamel, thereby placing upon the metal a neutral layer, over which a higher type of finish can be applied. This is particularly true in the production of white enamel, if a pure color tint, free from black specks, is desired.

Enamels which are otherwise difficult to apply commercially, such as special delicate colors and acid-resistant enamels, may easily be produced when a suitable ground coat is employed; whereas if applied directly on the iron, the qualities desired in the finished product may not be obtainable.

Ground coats of the mat or semivitrified type are of particular advantage on heavy castings of unequal thickness, as well as on castings of poor quality, spongy appearance, etc., inasmuch as the "filler" can better be held down in the slag holes and other cavities.

### Spraying and Drying

Proper spraying technique is at all times an aid toward producing quality ware. The important item is to obtain an evenly distributed coat, free from streaks or spots of thin and thick enamel, so that the enamel may fuse in a uniform manner. Care should be used not to "double" on the corners of pieces in spraying, as this will make the enamel coating quite heavy in these spots.

Rapid drying of the sprayed ground coat or first coat minimizes

rusting in the coating, and is advisable. The drying should be from the bottom of the enamel layer out toward the surface if possible, to eliminate "tearing" or "crawling."

### Proper "Comeback" of the Furnace

For the production of a high quality vitreous enamel finish on cast iron it is necessary not only for the proper enamel to be applied on correctly designed castings, but also that the control of the burning temperature, burning time, and "speed" at which the enamel coated castings approach the burning temperature or maturing temperature of the enamel, be watched.

In general, enamels for cast iron should be burned at a temperature just hot enough to cause them to fuse or burn down smoothly and acquire the proper finish. This applies not only to cover-coat enamels, but also to first-coat enamels.

If the furnace temperature is too high, there is danger of the enamel becoming overburned, losing gloss and mechanical strength. This is particularly true if the castings are of unequal thickness, in which case the enamel over the thin portions of the castings (which portions absorb heat faster than the heavier parts) will be fused down to a gloss while the rest of the enamel is still unfused. Then by the time the enamel over the heavier section of the castings is fired to a gloss, the enamel over the thin portion of the castings is overfired.

If, on the other hand, the temperature is not higher than that required to burn the enamel properly, the casting itself will heat up more uniformly, without danger of overburning the enamel. It is well known that the thicker the enamel on the iron, the longer will be the time necessary to burn it properly, and the thinner the enamel the easier it may be burned.

Likewise the heavier a casting, the longer it must be heated to bring it up to the proper maturing temperature of the enamel, and the slower the casting must be heated in order to "soak" it with the heat and allow it to reach the finishing temperature of the enamel.

Around almost every enameling furnace burning cast-iron enamel, we hear the burners speak of the "comeback" of their furnaces. By the term "comeback," they mean the length of time it takes the furnace to return to the finishing temperature after they introduce the ware into the furnace. Thus if a load of enamel-coated castings is run into the furnace at 1320°F and the temperature drops to 1200°F, coming back to 1320°F in fifteen minutes, the burner will say his furnace has a fifteen-minute comeback. Theoretically, the enamel should be properly matured and ready to remove from the furnace when the furnace temperature comes back to its peak. This will be true if the furnace

has the proper time-comeback. If the comeback of a furnace is too fast there is danger of the enamel showing defects.

Generally speaking, if the comeback of a furnace is too fast, less heat should be applied to the muffle; if the comeback is too slow, more heat should be applied to the muffle.

It must be borne in mind, however, that each furnace has a natural comeback of its own, dependent upon the muffle material, thickness of the muffle, type of fuel, drafts, etc. Thus if a furnace has a natural fast comeback, it is entirely possible that applying less heat to the muffle will but temporarily result in a slower comeback, and that other expedients will have to be resorted to in order to attain the slower comeback.

The substitution of a low conductivity refractory for a high conductivity refractory muffle material, particularly in the bottom of the muffle, should slow down the comeback, and vice versa.

The weight of a load which is run into the furnace will also affect the comeback. A 400-pound load of cold castings going into a furnace will naturally pull the furnace temperature down more than a 200-pound load, and having pulled the temperature down more, it is only natural that the furnace will take longer to come back to the initial temperature.

Little trouble, except loss of production, is suffered from too slow a furnace comeback, provided the furnace temperature returns to the proper peak. Too fast a furnace comeback, however, can cause serious difficulties. Such a condition does not allow thin and thick sections of castings to reach the maturing temperature of the enamel together, and consequently overburning or blisters may result.

Almost all cast-iron enamels seem to undergo a certain amount of blistering about the time the enamel starts to fuse. These blisters, however, break and the enamel flows and heals over in the last few minutes of heating in the furnace, unless there are such impurities in or on the surface of the iron which continue to burn out, not allowing the blisters to heal over. Needless to say, the furnace temperature should not be so high during this blister-healing period as to overburn the enamel. Therefore, the comeback of the furnace should not be too fast.

### Advantages of Multiple-Decking Equipment

In the case of castings of great difference in thickness, castings reinforced with ribs or having lugs on them, the unevenness of heating up of the castings was formerly avoided by pulling or removing the load from the furnace for a minute or so about the time the enamel started to fuse. This allowed the thinner portions of the casting to cool down somewhat, while the heavier portions retained their heat. Then

when the castings were put back into the furnace, the heavier sections and the lighter sections came up to the maturing temperature of the enamel at about the same time. These remarks apply particularly to the days when but a single "deck" or tier of castings was burned in a furnace.

This situation more or less takes care of itself in the case of extremely heavy loads in the furnace, or where double or triple decking practice is carried out. Here the large weight of cold cast iron in addition to the cold burning bar equipment pulls the furnace temperature down considerably and allows the load to come back to the enameling temperature gradually while the light and heavy portions of the castings heat up quite uniformly. In this way multiple decking practice eliminates removing ware from the furnace to chill the castings, develops a better time-temperature comeback, and incidentally as important as any other feature, affords increased production.

FERRO ENAMELING COMPANY
CLEVELAND, OHIO

---

## DISCUSSION ON "ACID-RESISTANT ENAMELS"[1]

BY CHARLES MUSIOL[2]

It is important that enamel men be informed exactly about the enamel qualities such as the expansion of elasticity, strength, and their theoretical determinations.

There are inaccuracies and errors in Mr. Malinovszky's paper which should be rectified.

If the oxide formula of the enamel given in Table I is correct, then the molecular formula is erroneous. The exact Seger formula would be:

| | | | | | |
|---|---|---|---|---|---|
| 0.5093 | $Na_2O$ | | | 0.2985 | $B_2O_3$ |
| 0.0828 | $K_2O$ | | | 1.0472 | $SiO_2$ |
| 0.1052 | CaO | 0.1664 | $Al_2O_3$ | 0.0183 | $Sb_2O_5$ |
| 0.3027 | ZnO | | | 0.2515 | $F_2$ |
| 1.0000 | | | | | |

A big difference is seen in the values of $B_2O_3$ and $Sb_2O_5$. This error would not have been possible had Mr. Malinovszky used the centesimal molecular formula described in a paper by the writer on "Exact Notions of Fluorine Enamels."[3]

---

[1] A. Malinovszky, "Acid Resistant Enamels," *Jour. Amer. Ceram. Soc.*, **11** [2], 110 (1928).

[2] Received February 25, 1928.

[3] C. Musiol, *Jour. Amer. Ceram. Soc.*, **7** [2], 105 (1924). See also discussion on this paper in *Bull. Amer. Ceram. Soc.*, **3** [6], 224–28 (1924).

Any error present is visible and can be rectified at once.

| | Mol. % | | |
|---|---|---|---|
| $Na_2O$ | 20.130 | $B_2O_3$ | 11.800 |
| $K_2O$ | 3.273 | $Al_2O_3$ | 6.575 |
| CaO | 4.160 | $SiO_2$ | 41.400 |
| ZnO | 11.960 | $Sb_2O_5$ | 0.721 |
| | 39.523 | $F_2$ | 9.940 |
| | | Total | 109.959 |
| | | | −9.940 |
| | | | 100.019 |

Mr. Malinovszky's method for finding the values of elasticity, of tensile strength, and of compression strength is not clear. Are these values found by experiment or by calculation?

As far as I know the glass and enamel literature does not contain other coefficients about elasticity and strength in terms of composition, as those of Winkelmann and Schott.

Among them there are no coefficients of $Sb_2O_5$ or $SnO_2$, $ZrO_2$, $CaF_2$, $Al_2F_6$, $Na_2F_2$, and $F_2$.

To presume in imitation of Vielhaber (Rezept-Taschenbuch) that all fluorine is evaporated and that

$$1NaF = 0.715\ Na_2O$$
$$1AlF_3 = 0.615\ Al_2O_3$$
$$CaF_2 = 0.715\ CaO$$
$$1SiF_2 = 1.361\ SiO_2$$

which factors help to calculate the elasticity and strength values, is not scientifically proved for it is not admissable and is certainly not true.

If the values of Mr. Malinovszky's article are calculated in this manner they are not only worthless but misleading to the enamelist who wishes to learn something in the *Journal of the American Ceramic Society*.

RUE DE LA BIGORNE, 16
BRUSSELS, BELGIUM

---

A. MALINOVSZKY:[4] When one considers the complexity of a smelted batch of enamel, the calculation of the coefficient of expansion, elasticity, tensile and compression strength, which are all valuably involved in such, it is practically impossible from a scientific viewpoint, to accurately compute such a silicate mixture.

At present we have no other factors or methods available, other than those now published, and until we have others which are proven scientifically correct, we shall have to accept those which are known to us at present.

[4] Received March 22, 1928.

We know that those factors or methods, which have been scientifically condemned, serve at present in our daily shop practice and are giving very satisfactory results in our daily commercial production so that we are able to properly control the enamel.

Factors given by Winkelmann and Schott, and later applied and published by Staley and Froelich for the enamel industry, are most indispensible to those who are interested in formulating and mixing the ground coat and enamel. It is possible by this time to control the losses caused by chipping, crazing, and lifting.

The practical value of these factors and the methods embodied, have proved successful, and, for this reason, have been adopted as a guide in every enameling plant.

The empiric or the centesimal molecular formula, has no meaning and is absolutely impractical when considering a complex mixture such as a smelted batch of enamel.

I am submitting two analyses of material, volatilized and collected in the flue and stack and which were taken from the base of the smelter stack, showing that correct calculations cannot be determined due to the fact that this is missing from the calculated raw batch. The analyses have been made on samples taken from the stack every three months.

| | Per cent | |
|---|---|---|
| $SiO_2$ | 22.12 = | 19.81 |
| $Al_2O_3$ | 2.81 = | 5.48 |
| $Fe_2O_3$ | .76 = | 1.01 |
| CaO | 2.49 = | 1.29 |
| MgO | 1.12 = | .49 |
| $B_2O_3$ | 8.79 = | 11.26 |
| PbO | 4.12 = | 8.63 |
| ZnO | 1.09 = | 2.31 |
| $Na_2O$ | 11.26 = | 9.84 |
| $K_2O$ | 3.57 = | 1.16 |
| F | 38.26 = | 35.90 |
| $SnO_2$ | 2.37 = | 1.16 |
| $TiO_2$ | 1.11 = | .86 |
| | 99.87 = | 99.20 |

I have proved this to my satisfaction on numerous occasions by mixing commercial and small experimental batches from materials which have previously been carefully analyzed in our laboratory and after the batch had been smelted.

It has been found by these analyses, that there are great differences of the elements from the calculated raw and smelted batch, as seen from the two analyses above.

We also have found that the $SiO_2$ and $Al_2O_3$ were high in some batches and low in others. Free $SiO_2$ can be found in every ground enamel batch, introduced from the lining of the mill, or from the grinding balls, especially when silex is used.

Fluorine is bound to be driven off first from the batch during the smelting operation taking other oxides from the batch, and others perhaps are brought into the batch from the linings of the smelter. This will undoubtedly affect the correctness of the calculated empiric formula.

As shown by Staley and others, three digits difference in coefficient of expansion between the calculated raw batch and the melted batch do not affect the enamel. (I have found that even 14 cause no serious trouble.)

The calculations of those three formulas published in the *Journal* were calculated by reducing every component to its simple oxide state and then calculated as usually is done for enamel.

The elasticity, tensile and compression strength of the three batches of acid-proof enamels were calculated with those factors and methods given by Louis Vielhaber in his two books, "Rezept Taschenbuch" and "Die Konstruktion der Emaillenversatze."

We know of course, that these factors have not been accurately proved in a scientific manner in the case of such complex silicates, and I doubt whether it can be proved. These factors have been used only to determine the relation (if there is one) between calculated results *vs.* results obtained by the coefficient of expansion.

The batch having the coefficient of expansion of 266.49 chipped very badly and the enamel was quite hard and set rapidly. It was found difficult to patch such an enamel as it chipped while it was warm.

This again proves the correctness recompense and practical value of calculations of expansion which is the only guide we have with the present factors.

The other two batches with the higher coefficient of expansion did not chip.

WASHINGTON IRON WORKS
LOS ANGELES, CALIF.

---

## BIBLIOGRAPHY OF PLASTICITY

BY PAUL J. SLEGEL[1]

**A. S. Ackerman.**

"Physical Properties of Clays," *Trans. Soc. Eng.*, 1919–20–21–22.

**Harrison E. Ashley.**

"Development of Plasticity in Presence of Water," *Trans. Amer. Ceram. Soc.*, **11**, 574 (1909).*

"Relation between Plasticity and Soluble Salts," *Ibid.*, **11**, 594–95 (1909).*

[1] Student, Iowa State College, Ames, Iowa.

"Supposed History of the Development of Plasticity of Clays in Nature," *Ibid.*, **11**, 582 (1909).*

"Technical Control of the Colloidal Matter of Clays," U. S. Bur. Stand., *Tech. Paper*, No. 46 (1915).

"The Colloidal Matter of Clay and Its Measurement," U. S. Geol. Surv., *Bull.*, No. 388.

**Albert Atterburg.**

"Plasticity of Clay," *Tonind. Ztg.*, **35**, 1460 (1911).

**W. D. Bancroft and L. E. Jenks.**

"The Plasticity of Clay," *Jour. Phys. Chem.*, **29** [10], 1215–16 (1925).

**A. V. Bleininger.**

"Ceramic Processes Associated with Colloid Phenomena," *Jour. Ind. Eng. Chem.*, **12**, 436 (1920).

"The Effect of Preliminary Heat Treatment upon Clays," *Trans. Amer. Ceram. Soc.*, **7**, 392 (1905).

**A. V. Bleininger and C. E. Fulton.**

"The Effect of Acids and Alkalis upon Clay in the Plastic State," Univ. of Ill., *Bull.*, No. 17; *Trans. Amer. Ceram. Soc.*, **14**, 827–37 (1912).

**M. A. Bigot.**

"Different Types of Plasticity of Clays and Kaolins," *La Ceramique*, **26**, 194 (1923).

**E. C. Bingham.**

"Discussion on Plasticity," *Bull. Amer. Ceram. Soc.*, **3** [10], 375 (1924).

"Plasticity," *Jour. Phys. Chem.*, **29** [10], 1201–1204 (1925).

"Plasticity and Elasticity," *Jour. Franklin Inst.*, **197**, 99 (1924).

"Plasticity in Colloid Control," 2nd Colloid Symposium Monograph, pp. 106–13, 1925.

**E. C. Bingham and H. A. Murray, Jr.**

"A New Combined Viscometer and Plastometer." *Proc. A.S.T.M.*, **23** [2], 655 (1923).

**E. C. Bingham, Herbert D. Bruce, and Martin O. Wolbach, Jr.**

"The Plastometer as an Instrument for Process Control," *Jour. Ind. Eng. Chem.*, **14**, 1014 (1922).

**G. A. Bole.**

"Mechanism of Plasticity from Colloidal Standpoint," *Jour. Amer. Ceram. Soc.*, **5** [8], 469 (1922).

**R. Bradfield.**

"The Relation of Hydrogen-Ion Concentration to the Flocculation of a Colloidal Clay," *Jour. Amer. Chem. Soc.*, **45**, 1243 (1923).

**F. G. Breyer.**

"Some Observations on the Plasticity Symposium." *Jour. Phys. Chem.*, **29**, 1266 (1925).

**G. H. Brown and E. T. Montgomery.**

"Dehydration of Clays," U. S. Bur. Stand., *Tech. Paper*, No. 21 (1913).

"Loss in Plasticity Due to Heating," *Trans. Amer. Ceram. Soc.*, **14,** 716 (1912).*

**John D. Brumbaugh.**

"Electrolytes' Effect on Plastic Clay," *Brick Clay Rec.*, **62,** 221 (1923).

**Stanley G. Burt and Edward Orton, Jr.**

"Discussion on the Effect of Aging Clay to Increase Plasticity," *Trans. Amer. Ceram. Soc.*, **3,** 175, 178–179 (1901).*

**P. Carre.**

"Plasticity and Cohesion of Clays," *La Ceramique*, **14,** 7 (1911).

**Herbert Chatley.**

"Molecular Force and Plasticity of Clays," *Trans. Ceram. Soc.* [Eng.], **19,** 1 (1919–20).

**P. E. Cox.**

"A Study of Plasticity by Practical Potter's Method," *Jour. Amer. Ceram. Soc.*, **7** [3], 151 (1924).

**Allerton S. Cushman.**

"The Colloid Theory of Plasticity," *Trans. Amer. Ceram. Soc.*, **6** 65 (1904).

**V. H. Davis.**

"A Study of the Physical Properties of Clay as Related to the Soil Structure," *Agr. Student*, **7,** 15 (1900).

**N. B. Davis.**

"The Plasticity of Clay," *Trans. Amer. Ceram. Soc.*, **14,** 826 (1912).

**A. DeWaele.**

"Apparent Paradox of Plasticity," *Kolloid Zeits.*, **38,** 257–59 (1926). *Chem. and Ind.*, **45B,** 391 (1926).

"Note on Plasticity," *Kolloid Zeits.*, **38,** 27 (1926).

"Viscometry and Plastometry." *Jour. Oil Colour Chem. Assn.*, **6,** 33–88 (1923).

**H. W. Douda.**

"The Effect of Wet Grinding, Screening, and Electrolytes and Dextrin on Clays of Low Plasticity and Strength," *Jour. Amer. Ceram. Soc.*, **3** [11], 885 (1920).

**Warren E. Emley.**

"An Instrument for Measuring Plasticity," *Trans. Amer. Ceram. Soc.*, **19,** 523 (1917).

"The Deformation of Plastic Bodies under Compression as a Measure of Plasticity," *Trans. Amer. Ceram. Soc.*, **17,** 612 (1915).

**Wesley G. France.**

"An Ultramicroscopic Motion Picture Study of the Relation of

Colloidal Content and Plasticity in Clays," *Jour. Amer. Ceram. Soc.*, **9** [2], 67 (1926).

**E. E. Free.**

"The Phenomena of Flocculation and Deflocculation," *Jour. Franklin Inst.*, **169,** 421 (1909); **170,** 46 (1910).

**William Gates.**

"Causes of Plasticity," *Trans. Amer. Ceram. Soc.*, **7,** 43 (1905).*

**S. Geijsbeek.**

"Effect of Size of Grog Grain upon Plasticity," *Trans. Amer. Ceram. Soc.*, **7,** 137 (1905).*

**George P. Grimsley.**

"Plasticity," *W. Va. Geol. Surv.*, **3,** 35 (1905).

**F. F. Grout.**

"The Plasticity of Clays," *Jour. Amer. Chem. Soc.*, **17,** 1037–49 (1895).

**F. P. Hall.**

"The Plasticity of Clays," *Jour. Amer. Ceram. Soc.*, **5** [6], 346 (1922).

**W. A. Hamor and H. E. Gill.**

"On the Effect of Extraction upon the Plasticity of Clays," *Jour. Amer. Ceram. Soc.*, **2** [8], 594 (1919).

**H. Hirsch.**

"Measurement of Plasticity by Adsorption," *Trans. Amer. Ceram. Soc.*, **11,** 541 (1909).*

**A. L. Hudges.**

*"Measurement of Plasticity in Clay," *Brick*, **30,** 197 (1909).

**M. Jacoby.**

"Influence of Alkalis, Acids, and Salts on the Plasticity of Kaolin," *Ber. deut. keram. Ges.*, **6,** 97 (1925); *Keram. Rund.*, **32,** 634 (1924); *Jour. Soc. Glass Tech.*, (abs.) **9,** 150 (1925).

**Alfred Francis Joseph and John Stanley Hancock.**

"The Composition and Properties of Clays," *Jour. Chem. Soc.*, **125,** 1888 (1924).

**Gustav Keppeler.**

"Concerning the Plasticity of Clay," *Tonind. Ztg.*, **51** [8], 105–107 (1927).

**C. H. Kerr and C. E. Fulton.**

"The Effects of Some Electrolytes on Typical Clays," *Trans. Amer. Ceram. Soc.*, **15,** 184 (1913).

**C. S. Kinnison.**

"A Study of the Atterberg Plasticity Method," *Trans. Amer. Ceram. Soc.*, **16,** 472 (1914). U. S. Bur. Stand., *Tech. Paper*, No. 46 (1915).

**F. A. Kirkpatrick, and W. E. Orange.**
"Test of Clays and Limes by the Bureau of Standards Plasticimeter," *Jour. Amer. Ceram. Soc.*, **1** [3], 170 (1918).

**H. Kohl.**
"The Modulus of Rupture of Dried Clays as a Measure of Plasticity," *Ber. deut. keram. Ges.*, **7** [1], 19–31 (1926).

**S. Kondo.**
"Action of Electrolytes on Clays," *Jour. Soc. Chem. Ind.*, (Japan), 1, 1925; *Jour. Soc. Chem. Ind.*, **45** (1926).

**C. E. Krauss.**
"Ceramic and Refractory Materials," Brit., pp. 224–57, May 1, 1923.

**Henry B. Kummel.**
"Plasticity of Clay," *N. J. Geol. Surv.*, **6**, 81 (1904).

**R. F. MacMichael.**
"The Phenomena of Clay Plasticity Explained," *Brit. Clayworker*, **29**, 163 (1920–21); *Brick Clay Rec.*, **55**, 677–80 (1919).

**Ernest Mayer.**
"Relation between Mica and Plasticity in Clays," *Trans. Amer. Ceram. Soc.*, **2**, 99 (1900).*

**J. W. Mellor.**
"On the Plasticity of Clays," *Trans. Ceram. Soc.* [Eng.], **21**, 91 (1921–22); *Trans. Faraday Soc.*, **17**, 354 (1921); Communication from The Clay and Pottery Laboratory, Stoke-on-Trent, No. 53.
"The Plasticity of Potter's Materials," *Trans. Ceram. Soc.* [Eng.], **4**, 72 (1904–05).

**J. W. Miller, N. Sinclair, and P. S. Deveriux.**
"The Dehydration of Dried Clays," *Trans. Ceram. Soc.* [Eng.], **21**, 104 (1921–22).

**Minnemann.**
"Note on the Restoration of Plasticity to Potter Scrap Clay," *Trans. Amer. Ceram. Soc.*, **16**, 96 (1914).

**C. Mira.**
"Influence of Electrolytes on the Plasticity of Clays," *Rev. Mat. Constr. Trav. Pub.*, **190**, 156–57B; **191**, 177–79B.

**E. Orton, Jr.**
"Note on a Crystallized Kaolinite," *Trans. Amer. Ceram. Soc.*, **3**, 219 (1901).
"Plasticity Modified by Size and Quantity of Grains of Non-plastic Matter," *Trans. Amer. Ceram. Soc.*, **2**, 101 (1900).*

**Wolfgang Ostwald.**
"The Importance of Viscosity for the Study of the Colloidal State," *Trans. Faraday Soc.*, **9**, 34–46 (1913).

**K. Pfefferkorn.**

"Measuring Plasticity of a Clay," *Brit. Clayworker*, **33,** 120 (1924).

"The Plasticity of Clays and Kaolins," *Sprechsaal*, **57,** 297 (1924); **58,** 183 (1925).

**E. Podszus.**

"Plasticity," *Kolloid Zeitschrift*, **20,** 65 (1917).

**Frederick Poppe and F. F. Grout.**

"The Plasticity of Clay," *Trans. Amer. Ceram. Soc.*, **14,** 71 (1912).

**Ross C. Purdy.**

"Plasticity," Ill. Geol. Surv., *Bull.* No. 9, p. 173.

"Theory of Plasticity and Possible Commercial Application," *Bull. Amer. Ceram. Soc.*, **1** [4], 147 (1922).

**R. Rieke.**

"Plasticity of Clays," *Sprechsaal*, **44,** 597 (1911).

**R. Rieke and E. Sembach.**

"Plasticity Determinations of Kaolins and Clays," *Trans. Ger. Ceram. Soc.*, **6** [3], 111 (1925).

**R. Rohland.**

"The Means for Altering the Amount of Plasticity of Clays," *Sprechsaal*, **39,** 1371–72 (1906).

**Max Rosenow.**

"Plasticity of Clay," *Tonind. Ztg.*, **35,** 1261 (1911).

**Otto Ruff.**

"Plasticity," *Z. Anorg. Allgem. Chem.*, **133,** 187 (1924).

**Otto Ruff and Wilhelm Gobel.**

"Plastic Material from Aluminium Oxide," *Z. Anorg. Allgem. Chem.*, **133,** 220–29 (1924).

**Otto Ruff and Josef Moczala.**

"Plastic Materials from Zirconium Dioxide," *Z. Anorg. Allgem. Chem.*, **133,** 193–219 (1924).

**H. Salmang.**

"Causes of Plasticity of Clay," *Z. Anorg. Allgem. Chem.*, **162,** 115–26 (1927).

**A. Schoblick.**

"Bacteria in Whiteware Bodies," *Keram. Rund.*, **33,** 893 (1925).

**H. G. Schurecht.**

"Relation of Structure of Clay Grains to the Plasticity of Clays," *Bull. Amer. Ceram. Soc.*, **1,** 153 (1922).

"The Use of Electrolytes in the Purification and Preparation of Clay," U. S. Bur. Mines, *Tech. Paper*, No. 281 (1922).

**H. Spurrier.**

"Continuity in Plastic Bodies," *Jour. Amer. Ceram. Soc.*, **9** [8], 535 (1926).

"The Why of Aging Clay," *Jour. Amer. Ceram. Soc.*, **4** [2], 113 (1921).

**J. Stewart.**

"The Plasticity of Clay," Orig. Comm., *8th Int. Congr. Appl. Chem.*, **15**, 265 (1912); *Jour. Ind. Eng. Chem.*, **5**, 421 (1913).

**Edward C. Stover.**

"Bacterial Growth as a Factor in Aging Clay Mixtures," *Trans. Amer. Ceram. Soc.*, **4**, 183 (1902).

**Edward C. Stover and Jacob Lindley.**

"A Note on the Measurement of Plasticity and Tensile Strength," *Trans. Amer. Ceram. Soc.*, **7**, 397 (1905).

**T. W. Talwalkar and C. W. Parmelee.**

"Measurement of Plasticity," *Jour. Amer. Ceram. Soc.*, **10** [9], 670–85 (1927).

**C. Terzaghi.**

"New Facts about Surface Friction," *Phys. Rev.*, **16**, 54 & 61, 1920.

**A. von Baranoff.**

"The Plasticity of Clay," *Z. Tech. Physik*, **1**, 191–92 (1926).

**Hugh E. Weightman.**

"Service Requirements for Plastic Refractories," *Bull. Amer. Ceram. Soc.*, **5** [4], 210 (1926).

**H. A. Wheeler.**

"Discussion on the Relation of Plasticity to Tensile Strength," *Trans. Amer. Ceram. Soc.*, **6**, 82–84 (1904).

"Plasticity of Clays," *Missouri Geol. Surv.*, **11**, 95 (1896).

**Robert E. Wilson and F. P. Hall.**

"The Measurement of the Plasticity of Clay Slips," *Jour. Amer. Ceram. Soc.*, **5** [12], 916–27 (1922).

**William H. Zimmer.**

"Plasticity *vs.* Moisture and Chemically Combined Water," *Trans. Amer. Ceram. Soc.*, **3**, 34 (1901).*

**B. Zschokke.**

"Investigations on the Plasticity of Clays," *Bull. Soc. d'Encouragement*, **103**, 619 (1902); *Tonind. Ztg.*, **29**, 1657 (1905).

**Miscellaneous.**

"Standard Method for Water of Plasticity," Amer. Ceram. Soc., *Year Book*, p. 41, 1922.

"Is Plasticity of Practical Value?" (Editorial Staff Report) *Chem. and Met. Eng.*, **31**, 628 (1924).

"Clasticity and Plasticity," (Editorial) *Bull. Amer. Ceram. Soc.*, **6** [7], 179–80 (1927).

* These are short references, taken from articles which are not devoted to the discussion of plasticity, and yet contain one or two pages relating to plasticity.

# ACTIVITIES OF THE SOCIETY

## ADDITIONAL PROGRAM FOR CERAMISTS' TOUR ABROAD

Within two weeks from the issuance of this *Bulletin* the ceramic party will be on the deep blue sea, sailing to foreign lands to meet fellow manufacturers abroad. The itinerary items given in the April *Bulletin* and those printed here are the details and the optional choices in addition to those shown in the special descriptive tour booklet.

A rare opportunity is this, as is evidenced by the many letters already reproduced in the *Bulletin* and in special circulars, and which are still coming to us from our hosts abroad who are more than anxious to extend every courtesy to their long-awaited guests.

FIG. 1.—Machine house at the Pillinge Works of the London Brick Co. & Forders, Ltd. 700 million press brick, annual production.

Czechoslovak Consulate General
1440 Broadway,
New York City

April 6, 1928

To the Ceramists:

The intinerary of the four-day visit has been prepared by the Czechoslovak Ceramic Society in coöperation with the ministry of Commerce and is set out as follows:

June 8: At their arrival in Carlsbad the AMERICAN CERAMIC SOCIETY will be welcomed by representatives of the Czechoslovak Ministry of Commerce and by several members of the Czechoslovak Ceramic Society. During the afternoon there will be sightseeing in Carlsbad and later dinner in the hotel where the party may stay.

June 9: (1) Inspection of the professional school for the porcelain industry. (2) Kaolin mines. During the afternoon, inspection of the kaolin industries at Pirkenhammer. Visit the Springs and afternoon tea at Freundschaftshohe. Leave Carlsbad at 5 P.M. by express for Prague.

10 P.M. Seeing Prague at night by Cedok's motor cars.

June 10: 10 A.M.–1 P.M. Sightseeing in Prague by Cedok's cars, mutual exchange of honorary memberships between the AMERICAN CERAMIC SOCIETY and the Ceramic Society of Czechoslovakia.

June 11: Visit the Exhibition of Contemporary Culture, Brno, and the State Institute for Silicate Industry. Should the time permit, visit the Slovak Brick Works at Hodonin.

The arrangements for the whole visit of the AMERICAN CERAMIC SOCIETY in Czechoslovakia is intrusted to Dr. Jankovic of the Cedok Travel Bureau, who will personally take care of the whole party.

Trusting that the visit in Czechoslovakia will be agreeable to you, I am, dear Sir,

Very sincerely yours,
Dr. J. Novak, Consul General

FIG. 2.—The clay pit at the Pillinge Works of the London Brick Co. & Forders, Ltd.

Berlin NW 87, Wegelystr. 1.
March 31, 1928.

AMERICAN CERAMIC SOCIETY,
Columbus, Ohio.
U. S. A.

Inclosed we are sending you three programs for the arrangements which are planned for the occasion of your European trip. We assume that you will take care of the hotel reservations, so that we shall not conflict with your arrangements. We are, however, ready to support you with counsel and action, but must request that you let us know your desires.

Respectfully,
Deutsche Keramische Gesellschaft E.V.
The Manager.
Mehrung.

**Program for the German Tour of the American Ceramic Society**

(Arranged by the German Ceramic Society)

| | | |
|---|---|---|
| **June 12** | 7:00 P.M. | Arrival of the Americans in Dresden |
| | 8:00 | Greetings to the Americans in the City Exhibition Hall, by the following represented societies. |
| | 8:30 | Addresses of welcome<br>(*a*) The German Ceramic Society, Dr. Harkort, Berlin, President, (*b*) The Union of German Manufacturers of Refractory Products, Dr. Schults, President, (*c*) The German Society of Glass Technology, General Director Mundt, Brockwitz, (*d*) The Association of German Enamel Works, (*e*) Reply of the AMERICAN CERAMIC SOCIETY. |
| **June 13** | 9:00 A.M. | Departure by auto omnibus to Meissen |
| | 10:00 | Arrival in Meissen. Inspection of the Municipal Porcelain Works, with an address by General Director Pfeiffer on "The Development of the Meissen Porcelains." |
| | 12:30 P.M. | Trip to the Albrechtsburg |
| | 2:30 | Addresses: (*a*) General Director Jungeblut, "The Ceramic Industry in Germany," (*b*) A member of the AMERICAN CERAMIC SOCIETY |
| | 4:00 | Coffee in the Albrechtsburg. (The members are guests of the Municipal Porcelain Works of Meissen) |
| | 5:00 | Trip through the cathedral and the Albrechtsburg |
| | 6:00 | Return to Dresden |

An inspection of the Imperial Machine Works will be made at about 10:00 A.M., for the members of the German Ceramic Society who are participating in this day.

| | | |
|---|---|---|
| **June 14** | | Inspections according to choice |
| | | (*A*) Porcelain: (1) Meissen Stove and Porcelain Works, (formerly C. Teichert). Meissen, Neumarkt 5. Products: Special table and coffee service, art objects. |
| | 7:35 A.M. | Departure from Dresden |
| | 8:17 | Arrival in Meissen |
| | 12:26 P.M. | Departure from Meissen |
| | 1:23 | Arrival in Dresden |
| | 7:20 | Departure from Dresden |
| | 10:23 | Arrival at Berlin (A.) |
| | | (2) Kahla Porcelain Works, branch establishment, Freiberg, Saxony. Product: High tension porcelain and tableware. |
| | 7:38 A.M. | Departure from Dresden |
| | 8:42 | Arrival at Freiberg |
| | 1:43 P.M. | Departure from Freiberg |
| | 2:28 | Arrival at Dresden |
| | 7:20 | Departure from Dresden |
| | 10:23 | Arrival at Berlin (A.) |
| | | (3) Porcelain Factory of C. Tielsch & Co. A.-G., Waldenburg-Altwasser, Silesia. Product: All sorts of useful ware. |
| **June 13** | 8:10 P.M. | Departure from Dresden |
| | 12:41 A.M. | Arrival at Breslau |
| | | Spend the night in Breslau |
| **June 14** | 7:04 A.M. | Departure from Breslau |
| | 8:24 | Arrival at Altwasser |
| | 1:06 P.M. | Departure from Altwasser |
| | 9:11 | Arrival at Berlin |
| | | (*B*) Whiteware: (1) Meissen Stove and Porcelain Works (formerly C. Teichert). Meissen, Neumarkt 5. Product: Whiteware wall tile. |
| | 7:35 A.M. | Departure from Dresden |
| | 8:17 | Arrival at Meissen |
| | 12:26 P.M. | Departure from Meissen |
| | 1:23 | Arrival at Dresden |

| | | |
|---|---|---|
| | 7:20 | Departure from Dresden |
| | 10:23 | Arrival at Berlin (A.) |

(2) Ernst Teichert G.m.b.H., Meissen, Fabrikstr. No. 26. Product: Tiled ovens, wall tile, building products.

| | | |
|---|---|---|
| | 7:25 A.M. | Departure from Dresden |
| | 8:17 | Arrival at Meissen |
| | 12:26 P.M. | Departure from Meissen |
| | 1:23 | Arrival at Dresden |
| | 7:20 | Departure from Dresden |
| | 10:23 | Arrival at Berlin (A.) |

(*C*) Oven and Dutch Stove Ware: (1) Meissen Stove and Porcelain Works, (formerly C. Teichert), Meissen, Neumarkt 5. Product: Dutch stoves, wall fire places.

| | | |
|---|---|---|
| | 7:35 A.M. | Departure from Dresden |
| | 8:17 | Arrival at Meissen |
| | 12:26 P.M. | Departure from Meissen |
| | 1:23 | Arrival at Dresden |
| | 7:20 | Departure from Dresden |
| | 10:23 | Arrival at Berlin (A.) |

(2) Ernst Teichert G.m.b.H., Meissen, Fabrikstr. 26, Product: Dutch stoves, fireplaces.

| | | |
|---|---|---|
| | 7:25 A.M. | Departure from Dresden |
| | 8:27 | Arrival at Meissen |
| | 12:26 P.M. | Departure from Meissen |
| | 1:23 | Arrival at Dresden |
| | 7:20 | Departure from Dresden |
| | 10:23 | Arrival at Berlin (A.) |

(*D*) Stoneware and Clinkered Ware: (1) Fireclay and Mosaic Tile Works of Otto Kaufmann, Niedersedlitz, Saxony. Product: Wall and floor tile.

| | | |
|---|---|---|
| | 8:07 A.M. | Departure from Dresden |
| | 8:23 | Arrival at Niedersedlitz |
| | 12:39 P.M. | Departure from Niedersedlitz |
| | 12:54 | Arrival at Dresden |
| | 7:20 | Departure from Dresden |
| | 10:23 | Arrival at Berlin (A.) |

(2) German Clay and Stoneware Works A.-G., Works at Münsterberg, Silesia. Product: Stoneware, sewer pipe, agricultural articles, clinker brick, and all sorts of tile.

| | | |
|---|---|---|
| June 13 | 8:10 P.M. | Departure from Dresden |
| | 12:41 A.M. | Arrival at Breslau |
| | | Spend the night in Breslau |
| June 14 | 10:17 A.M. | Departure from Breslau |
| | 11:41 | Arrival at Münsterberg |
| | 2:07 P.M. | Departure from Münsterberg |
| | 9:08 | Arrival at Berlin (Fr.) |

(*E*) Refractory Products: (1) Kaempfe Bros. G.m.b.H., Fireclay Works, Eisenberg S.A. Product: Fireclay brick for all technical purposes, etc.

| | | |
|---|---|---|
| June 13 | 7:48/8:24 P.M. | Departure from Dresden |
| | 9:47/10:45 P.M. | Arrival at Leipzig |
| | | Spend the night in Leipzig |
| June 14 | 6:40 A.M. | Departure from Leipzig |
| | 7:45 | Arrival at Crossen (change cars) |
| | 7:54 | Departure from Crossen |
| | 8:27 | Arrival at Eisenberg |
| | 12:22 P.M. | Departure from Eisenberg |
| | 12:50 | Arrival at Crossen (change cars) |
| | 1:01 | Departure from Crossen |
| | 8:22 | Arrival at Berlin (A.) |

(2) German Clay and Stoneware Works A.-G., Works at Münsterberg, Silesia. Product: Fireclay normal brick and fireclay shapes of all sorts.

June 13 8:10 P.M. Departure from Dresden
12:41 A.M. Arrival at Breslau
June 14 Spend the night in Breslau
10:17 A.M. Departure from Breslau
11:41 Arrival at Münsterberg
2:07 P.M. Departure from Münsterberg
9:08 Arrival at Berlin (Fr.)

(*F*) Glass: Glasfabrik Aktiengesellschaft, Brockwitz. Post Sörnewitz near Meissen. Product: Pressed glass.

7:35 A.M. Departure from Dresden
8:17 Arrival at Meissen
Taken by auto to the plant and back
1:30 P.M. Departure from Meissen
2:17 Arrival at Dresden
7:20 Departure from Dresden
10:23 Arrival at Berlin (A.)

(*G*) Enamels: (1) Saxon Enamel and Stamping Works, (Formerly Gnächtel Bros. A.-G.), Lauter, Saxony. (2) Enamel Works at Grünhain, Saxony. The Bing Works, formerly Bing A.-G., Nürnberg

June 13 8:25 P.M. Departure from Dresden
10:16 Arrival at Chemnitz (overnight)
From Chemnitz on June 14, trip by auto omnibus to the above named plants and return to Chemnitz, there breakfast.
1:29/6:45 P.M. Departure from Chemnitz
5:11/10:23 Arrival at Berlin

June 15 Inspection of the city of Berlin according to the desires of the Americans

June 16 Inspections according to choice

(*A*) Porcelain:

9:00 A.M. (1) Municipal Porcelain Works of Berlin NW 87, Wegelystr. 1. (At Tiergarten Station). Means of transportation: Electric tramway No. 75 and 78, Auto omnibus No. 9; Railroad: Station Tiergarten.

9:30 A.M. (2) Porcelain Works Teltow G.m.b.H., Berlin-Teltow Product: Porcelain for electricians. Departure in separate autos at 9:00 A.M. from Potsdam Station. Arrival in Teltow at 10:00 A.M. Return to Potsdam Station at about 1:00 P.M.

(*B*) Whiteware

9:30 A.M. Whiteware Works Velten-Vordamm G.m.b.H., Velten Works.-Product: Hand decorated whiteware, faience, architectural ceramics
8:09 A.M. Departure from Stettin Suburban Station
8:54 Arrival at Velten
12:10/12:40 P.M. Departure from Velten
12:54/1:24 Arrival at Stettin Station

(*C*) Glass

9:30 A.M. Osram Mechanical Glass Works, Siemensstadt, Nonnendamm-Allee 49/59. Means of transportation: Electric tramway No. 55, 64.

(*D*) Institutes.

9:30 A.M. (1) Kaiser Wilhelm-Institut für Silikatforschung, Dahlem Fardeyweg 16. Means of transportation: Subway: Station Thielplatz

10:30 A.M. (2) Chemical technical experiment station at the Municipal Porcelain Works, Berlin-Charlottenburg, Berlinerstr. 9. Means of transportation: Electric tramway No. 75, 78. Auto omnibus No. 9. Railroad: Station Tiergarten.

| | | |
|---|---|---|
| **June 17** | | The morning is at the disposal of the Americans |
| | 1:00 P.M. | Departure from Berlin (Potsdam Station) |
| | 10:41 | Arrival in Cologne |
| **June 18** | | Inspections according to choice |
| | | (*A*) Refractory products: Silica Works of Henrich Koppers Co., Düsseldorf-Hardt. |
| | 8:45 A.M. | Departure from Cologne |
| | 9:26 | Arrival at Düsseldorf |
| | 2:16 P.M. | Departure from Düsseldorf |
| | 2:59 | Arrival at Cologne |
| **June 18** | | (*B*) Glass: Herzogenrath Glass Works of Bicheroux & Cie. G.m.b.H., Herzogenrath near Aachen. |
| | 8:30 A.M. | Departure from Cologne |
| | 10:47 | Arrival at Herzogenrath (change cars in Aachen) |
| | 1:09 P.M. | Departure from Herzogenrath |
| | 3:46 | Arrival at Cologne (change in Aachen) |
| | | Those participants who desire to see Aachen can also return at 4:55 P.M., arriving at Cologne at 6:04 P.M. |
| **June 19** | 5:48 P.M. | Departure from Cologne |
| | 10:05 | Arrival at Amsterdam |

Those members of the tour who do not care to go to Czechoslovakia may take the following trips:

| | | |
|---|---|---|
| **June 8** | 11:20 A.M. | Departure from Nürnberg or |
| | 8:20 | Departure from Munich |
| | 1:27 or 1:29 P.M. | Arrival at Marktredwitz |
| | | Inspections according to choice |
| | | (1) Porcelain Works of F. Thomas, Marktredwitz. Product: Vessels, gift articles, Christmas tree ornaments, laboratory porcelain. |
| | | (2) Porcelain Works of Waldershof A.-G., formerly Johann Haviland. Product: Dinnerware. From Marktredwitz by auto. |
| | | (3) Porcelain Works C. M. Hutschreuter A.-G., Hohenberg, Eger. Product: Tableware, etc. |
| | 1:32 P.M. | Departure from Marktredwitz |
| | 1:43 | Arrival at Arzberg |
| | | Further to Hohenberg by auto. Evening at the Luisenburg. |
| **June 9** | 11:35 A.M. | Departure from Marktredwitz |
| | 1:27 P.M. | Arrival at Selb |
| | | Inspections |
| | | (1) Porcelain Works of Ph. Rosenthal & Co. A.-G., Selb. Product: Useful and fancy ware, artistic porcelain, electrical pressed articles, high tension insulators. |
| | | (2) Municipal Technical School for the Porcelain Industry, Selb. |
| | 7:40 P.M. | Departure from Selb |
| | 8:00 | Arrival at Selb-Plösbg |
| | 8:30 | Departure from Selb-Plösbg |
| | 9:25 | Arrival at Hof |
| | | Spend the night in Hof |
| **June 10** | 7:47 A.M. | Departure from Hof |
| | 2:28 P.M. | Arrival at Dresden |
| **June 11** | | Inspection of Dresden according to choice |
| | | Participation in the 9th Convention of the German Ceramic Society in the afternoon. |

---

City Trade and Press Office
Trier, March 6, 1928.

AMERICAN CERAMIC SOCIETY,
New York, America.

From a note in the German press I take note that in May of this year you with about 200 members of your SOCIETY are going to make a study in Europe, which will also lead

you to Germany. I assume that you will not neglect to visit the Rhine, and take it upon myself to invite you to visit Trier, the oldest city in Germany. You may be assured that I shall do everything I can to make your stay within the walls of this old Roman city as pleasant as possible, and hope for a reply whether you are inclined to accept my invitation.

Respectfully,

The Oberbürgermeister
Kayser

City Trade and Press Office
Trier, Mar. 23, 1928.

AMERICAN CERAMIC SOCIETY
Columbus, Ohio, U. S. A.

From the copies of letters inclosed you can see that I have in view to win you to a visit to the interesting city of Trier. Unfortunately, according to a letter of the Deutschen Keramischen Gesellschaft, the program for your German tour is already completely fixed so that it does not appear possible to include the trip to Trier in the official plan. It might, however, be arranged that the participants on the trip to Aachen or Cologne who do not take the provided trips to Crefeld and Düsseldorf, make a side trip to the city of Trier.

I shall await with interest an obliging reply, whether some of the members can be counted in for the visit.

The Oberbürgermeister
I. A.
Kayser

Royal Hungarian Consulate
1529 Union Trust Building
Cleveland, Ohio.
April 6, 1928

Robert S. Hayes, Attorney-at-Law
35 East Gay St.,
Columbus, Ohio.
My dear Mr. Hayes:

May I ask you to do me a favor in a matter which I cannot attend personally and which I would like you to handle in my stead.

The AMERICAN CERAMIC SOCIETY intends to travel in Europe to study the ceramic industries of European countries. Since Hungary has a highly developed industry in ceramic products, the Hungarian Brick and Clay Products Manufacturers' Association, a prominent organization in Budapest, has sent a written invitation to the AMERICAN CERAMIC SOCIETY, extending a most cordial invitation to include Hungary in its trip.

Besides the natural and cultural attractions of Budapest, the Hungarian Ceramic industries are worthy of note in a study of this field. I wonder if you would call attention to the uniquely colored Zsolnay majolica of Pecs and the Herend china which is bought all over Europe, owing to the artistic designing and fine quality. In the city of Budapest itself, there are three factories in which faience porcelain and china are made.

The Hungarian Brick and Clay Products Manufacturers' National Association, as well as I, hope their invitation will be favorably received and accepted, upon your kind intervention.

Very truly yours,
Louis Alexy,
Consul.

The Ceramic Society
Stoke-on-Trent, England
March 9, 1928

Mr. Ross C. Purdy,
Secy. AMERICAN CERAMIC SOCIETY,
Columbus, Ohio
Dear Mr. Purdy:

*Visit of American Ceramic Society to England, 1928*

You will have received the full programme and list of Reception Committee* from which you will note that the Ceramic Society is entertaining

* See *Bull. Amer. Ceram. Soc.*, **7** [4], 89–94 (1928).

your party to luncheon in Stoke-on-Trent on Wednesday, June 27, and the British Pottery Manufacturer's Federation is entertaining your party to dinner on the same day. There is also to be a banquet in London on Friday, June 22.

I shall be very glad to have you give me the number to be present in your party as soon as possible.

The following works have invited your members to visit them while they are in Stoke-on-Trent:

W. H. Grindley & Co., Ltd., Tunstall
Johnson Bros. (Hanley) Ltd., Hanley
Geo. Jones & Sons, Ltd., Stoke-on-Trent
J. Maddock & Sons, Ltd., Burslem
Myott Son & Co., Cobridge
A. Meakin (Tunstall) Ltd., Tunstall
J. & G. Meakin, Ltd., Hanley
Wood & Sons, Ltd., Burslem
W. T. Copeland & Sons, Stoke-on-Trent
J. Wedgwood & Sons Ltd., Etruria
Mintons, Ltd., Stoke-on-Trent

Yours faithfully,
J. W. Mellor

(*CABLE JUST RECEIVED*)

Invitations have been received from the following enameling plants:
Angelo Enamelware Co., Stourport
Stokels Company, Burton-on-Trent
Plants at Hattem, Holland (Near Amsterdam).

---

## NEW MEMBERS RECEIVED FROM MARCH 1 TO APRIL 1

CORPORATION

**Universal Dental Co.,** Mfr. of Artificial Teeth, 48th & Brown Sts., Philadelphia, Pa. Joseph Kohn, Treas. and Mgr.

PERSONAL

**James H. Boring,** General Supt., Elgin Butler Brick Co., Elgin Texas.

**Cranston Howe Carpenter,** Consulting Engineer, Mansfield, Ohio, 403 W. Fourth St.

**Mortimer Levering Diver,** Consulting Engineer, P. O. Box 1073, San Antonio, Tex.

**Vernon M. Dorsey,** Counselor-at-Law, Dorsey & Cole., 635 F. St., N. W., Washington, D. C.

**Louis K. Friedman,** Homer Laughlin China Co., 5505 Woodmont St., Pittsburgh, Pa.

**Ruth C. Harmon,** Associate Editor, *The Enamelist*, The Ferro Enamel Supply Co., 2100 B. F. Keith Bldg., Cleveland, Ohio.

**Charles E. Lucke,** Professor, Columbia Univ., Physics Bldg., New York, N. Y.

**William Massie,** Foreman, Gurney's Enamel Dept., St. Laurent de Montreal, Que., Canada.

**W. E. Paterson,** c/o Stearne & Sons, Ltd., Brantford, Ont., Canada.

**Robert J. Rees,** Manager, Rhode Island Div., Corning Glass Works, 1181 Broad St., Central Falls, R. I.

**Homer L. Robson,** Chief Chemist, Burnham Chemical Co., Westend, San Bernadino Co., Calif.

**Vernon N. Rust,** Supt., Long Beach Glass Co., 2227 Cedar Ave., Long Beach, Calif.

**K. Sharashkin,** Voronzova Pole 18, Moskva, U.S.S.R.

**Konstantin T. Sharashkin,** Myasnitzkaya, 24, Institute of Silicates, Moscow, U.S.S.R.

**Fred L. Sleeper,** Mfg. Chemist, 1510 Diversey Parkway, Chicago, Ill.

**Rene Stolz,** Superintendent Enameling Works, De Dietrich & Cie., Zinwiller, Bas-Rhin, France.

**Roy Eliot Sturtevant,** Vice-President and Treasurer, Ludowici-Celadon Co., Room 1106, 104 S. Michigan Ave., Chicago, Ill.

**Maury L. Webster,** District Mgr., J. T. Thorpe & Son, Inc., (Furnace Construction) 321 W. Third St., Los Angeles, Calif.

**George F. Wilde,** Chemist, Matawan Tile Co., 82 Broadway Keyport, N. J.

STUDENT

**William K. Schweickhardt,** Missouri School of Mines and Metallurgy, Rolla, Mo.

**J. A. Oravec,** Univ. of Ill., Urbana, Ill.

**Membership Workers' Record**

| CORPORATION | | PERSONAL | |
|---|---|---|---|
| Office | 1 | P. William Lee | 1 |
| PERSONAL | | Alexander Loguin | 1 |
| A. I. Andrews | 1 | A. E. Stacey, Jr. | 1 |
| A. V. Bleininger | 1 | Office | 6 |
| G. W. Cooper | 1 | | — |
| B. K. Eskesen | 1 | Total | 19 |
| C. W. Ferguson | 1 | STUDENT | |
| Frank G. Gibson | 1 | A. I. Andrews | 1 |
| Karl Hart | 1 | C. M. Dodd | 1 |
| J. C. Hostetter | 1 | | — |
| Wm. V. Knowles | 1 | Total | 2 |
| N. P. Krassnikoff | 1 | Grand Total | 22 |

**Personal News from Members of the Society**

**The Akron Porcelain Company,** located at Akron, Ohio, is a recent reorganization of the Mogadore Insulator Co., Mogadore, Ohio.

**R. E. Arnold,** Mellon Institute, Pittsburgh, Pa., has accepted a position with the W. S. Dickey Co., Kansas City, Mo.

**Earle M. Champion** of the Babcock & Wilcox Co. has removed to Royersford, Pa. from Atlanta, Ga.

**The Corundite Refractories,** Inc., formerly known as the Massilon Stone & Fire Brick Co., is located at Massilon, Ohio, with a business office at Pittsburgh, Pa. T. C. Eayrs is general manager of this company.

**Charles Engelhard,** Inc., has removed from 50 Church Street, to 90 Chestnut Street, New York City.

**Richard D. Ferguson** is now in San Diego, Calif.

**Howard H. Mansur,** formerly a student at the University of Washington, Seattle, is located at Taylor, Wash.

**Karl Smith,** University of Illinois student is employed with the Charles Taylor Sons Co., Cincinnati, Ohio.

**A. G. T. Stallings,** formerly superintendent of the A. P. Green Fire Brick Co., Mexico, Mo. is situated at Tulsa, Okla., c/o S. H. Stayer.

**Roland V. Tailby** has moved from Highland Park, N. J. to 315 N. Penna. Ave., Morrisville, Pa.

**ENAMEL BIBLIOGRAPHY IN PREPARATION**

H. D. Carter and R. D. Landrum have in preparation a bibliography on enameling which will be issued soon by the AMERICAN CERAMIC SOCIETY through the Enamel

Division. Like all similar work the ideas of the compilers as to what should be included in this work have changed from time to time. At first it was their plan to include only the articles specifically on enameling. It was found, however, that many of the allied branches of the ceramic literature were of real interest; *e.g.*, those contained in the Bibliography on Plasticity by R. D. Cooke, and many of the reports of researches on glass and glass glazes and the various raw materials used in enameling could not be overlooked.

Even with this amplified field the work was finished up to 1927 in December of that year, but at that time the authors decided to enlarge their work by including all of the literature published in 1927. The major portion of this work is completed and the manuscript will soon be ready for the printer.

In the preparation of this Bibliography R. D. Landrum states

I wish every member of the Enamel Division had the opportunity of going through this literature as we have. He would have a truer conception of the great advances that have been made in enamel technology, especially in recent years, and would realize what a tremendous influence the AMERICAN CERAMIC SOCIETY and our Enamel Division has had upon this.

In 1904, there was practically nothing available upon enameling in the English language, except a few patents in the *Official Gazette* of the U.S. Patent Office. By far, the larger proportion of the 1555 abstracts which will be in this bibliography, by some 575 authors, are in the English language. Besides these, the Bibliography will contain some 475 patent references.

In preparing this Bibliography, we have used first hand original papers from the *Transactions, Journal*, and *Bulletin of the American Ceramic Society;* from *Ceramic Industry* and from the *Ceramist* (now *Ceramic Age*); we also have translated many articles from the *Keramische Rundschau* and *Sprechsaal*. The other references have been obtained from abstracts from the *Journal of the Society of Chemical Industry* (1882–1927); *Chemical Abstracts* (1907–1927); *Ceramic Abstracts* (1920–1927); and the U. S. Patents from the *Official Gazette* of the U.S. Patent Office (1872–1927). Some earlier references, mainly of historical value, have been taken from the Repertorium der Technischen Literatur (1823–1887).

It was quite a problem to decide upon the arrangement of this Bibliography. It was found impossible to group the articles as to subjects in a satisfactory manner. It was also found that a chronological arrangement would be meaningless. Our final decision was to group the abstracts as to author. This provides a natural grouping of material to some extent, and it also eliminates the necessity of an author index. Numerous articles have been listed alphabetically as to the publication in which they appeared.

Under each author, we have referred to his various discussions in literature, as well as to his original papers. There will also be included a very complete subject index.

---

## LOCAL SECTION NEWS

### Pittsburgh Section to Meet with A.S.M.E. May 14–17

The Pittsburgh Section of the AMERICAN CERAMIC SOCIETY plans to hold a joint session with the Management Section of the American Society of Mechanical Engineers. The Meeting will be held in the William Penn Hotel Monday afternoon, May 14, and will be part of the program of the general meeting of the A.S.M.E. H. M. Kraner of the Westinghouse Electric and Manufacturing Company will read a paper on the "Method of Workmen Payment in a Porcelain Factory."

On May 16 the Holley Medal will be presented to Elmer A. Sperry for his achievements in the invention of the gyroscope.

The Engineers Society of Western Pennsylvania will also coöperate in the planning and conducting of this event.

Three major trips of outstanding interest have been arranged by the committee covering three of the leading industries of Pittsburgh: iron and steel, glass-making, and

electrical machinery. Tuesday, May 15, the members will visit the principal plants of the United States Steel Corporation; on Wednesday afternoon the plant of the Westinghouse & Manufacturing Co. will be visited; and on Thursday afternoon there will be a trip to the American Window Glass Co. Invitations have been extended by many other industrial plants.

### April Meeting of Pittsburgh Section[1]

At a meeting of the Pittsburgh Section held on April 10, Wm. McCaughey of the Ohio State University spoke on the uses of the X-ray in ceramics. Dr. McCaughey described both the applications and the limitations of the X-ray camera in the field of silicate chemistry. A large number of ceramists from western Pennsylvania and eastern Ohio was present.

### Baltimore-Washington Section[1]

Members of the Baltimore-Washington Section met at the Olmsted Grill, Washington, D. C., on March 31, 1928 for the third meeting of the season. Twenty-five members were present.

The following papers were presented: (1) "The Technical Control in the Manufacture of Refractories," by L. J. Trostel, General Refractories Co., Baltimore, Md., and (2) "The Value of the Chemist in the Ceramic Industry," by A. N. Finn, Bureau of Standards, Washington, D. C. R. T. Stull presided as chairman of the meeting and gave interesting reminiscences which stimulated discussion. Karl Langenbeck discussed Mr. Finn's paper.

### California Section

Members of the California Section of the AMERICAN CERAMIC SOCIETY met at the Commercial Club, Los Angeles on March 12. There were sixty-six present for dinner, program, and business session.

Dr. Malinovszky's children presented a musical program during the dinner.

Robert Linton and T. S. Curtis presented a set of by-laws for the Section, which was adopted at this meeting.

The officers elected at this meeting were:
Chairman: Clifford Tillotson, Atlas Fire Brick, Co., Vice Chairman (southern Calif.): Charles Biddle, Alberhill Coal and Clay Co.
Vice Chairman (northern Calif.): Paul G. Larkin, Gladding, McBean Co.
Secretary: Franklin A. McCann, Pacific Clay Products Co.
Treasurer: Ivan B. Branham, Batchelder-Wilson Tile Co.
Executive Committee Members: Raymond Miller, Pittsburgh Plate Glass Co.; James W. Moncrieff, Stockton Fire Brick Co.
Executive members ex officio: B. M. Burchfiel, Pacific Clay Products Co.
Councillor: Fred B. Ortman, Gladding, McBean & Co.

The evening was devoted to a discussion on ceramic education. A. F. Gorton told of the breadth of education in the fields of science and arts that one must possess in order to cope with ceramic problems. Almost all of the ground work is now available in the schools of southern California, but the application of this work to ceramics has not been placed in any curriculum of a local school.

Mr. Linton, Chairman of the Committee on Ceramic Education told of his efforts to establish a ceramic course locally and in northern California. At present this work is established at Stanford University.

---

[1] R. F. Ferguson, *Secy.*

[1] R. A. Heindl, *Secy.*

## BY-LAWS OF CALIFORNIA SECTION AMERICAN CERAMIC SOCIETY

### Article I

### Membership

All members of the AMERICAN CERAMIC SOCIETY in good standing and resident in the State of California shall be members of the California Section.

### Article II

### Officers

The officers of the Section shall consist of a Chairman, two Vice-Chairmen, a Secretary, and a Treasurer. The offices of Secretary and Treasurer may be held by the same person. One Vice-Chairman shall be a member resident in Northern California, the other in Southern California.

### Article III

### Duties of Officers

(1) The Chairman shall preside at all meetings of the Section and of the Executive Committee. He shall appoint all standing and special committees, excepting as otherwise provided in these By-Laws, or otherwise designated by action of the Section at any regular meeting.

(2) The Vice-Chairmen shall perform the duties of the Chairman in his absence.

(3) The Secretary shall keep minutes of all meetings of the Section and of the Executive Committee and record them in permanent form. He shall conduct all correspondence with the National Headquarters of the SOCIETY, send to the *Bulletin* accounts for publication of the Section's activities, and see that notices are sent to members in advance of all meetings to be held.

(4) The Treasurer shall collect the dues and pay all bills incurred by the Section. He shall keep account of all money received and expended, and make a report of the same to the Section at the annual meeting.

(5) All officers shall hold office for the term of one year and until their successors are elected. The President shall not be eligible for re-election for the year immediately succeeding his term of service. In case of vacancies arising during the year, the Executive Committee may fill such vacancies with persons who shall serve until the next annual meeting.

### Article IV

### Standing Committees

(1) The Standing Committees shall be the Executive, Membership, Ceramic Education, and Nominating Committees.

(2) The Executive Committee shall be composed of the officers of the Section, together with the Past Chairman for the immediately preceding year and two other members elected by the Section. The Executive Committee shall arrange the programs for the meetings and other activities of the Section.

(3) The Membership Committee shall be charged with promoting memberships in the AMERICAN CERAMIC SOCIETY of persons engaged in ceramic industries and who are not members of the SOCIETY. It shall be the further duty of this Committee to secure attendance at meetings and interest in the Section's activities on the part of all members of the SOCIETY resident in California.

(4) The Committee on Ceramic Education shall maintain contacts with educational institutions in California and with employers of technical ceramists, with a view to providing courses of study which will fit students taking them for useful work in California ceramic industries.

(5) The Nominating Committee shall report at each annual meeting recommendations for a member to be elected to each office.

(6) The members of the Executive Committee shall be elected by the Section at its annual meeting. The Nominating Committee shall be selected by the Executive Committee. The members of the other standing committees shall be appointed by the Chairman.

### Article V
### Meetings

(1) The annual meeting of the Section shall be held on the second Monday in January of each year, provided however, that the Executive Committee shall have the power to designate a later date if in its judgment such later date would be more suitable. Notices of the time and place of the annual meeting shall be mailed to each member at least ten days in advance. Fifteen members shall constitute a quorum for the transaction of business. The order of business for the annual meeting shall be as follows:

Approval of Minutes
Report of Secretary
Report of Treasurer
Reports of Committees
Report of Nominating Committee
Other Nominations
Election of Officers
Miscellaneous Business

In addition to nominations presented by the Nominating Committee, nominations for members to fill any office may be made from the floor, and if seconded, shall be included in the voting. Voting shall be by ballot.

(2) Other meetings of the Section shall be held as and when arranged and called by the Executive Committee, but there shall be at least two meetings held each year.

### Article VI
### Dues

The dues of the Section shall be one dollar per year for each member, payable in advance in January of each year.

### Article VII
### Amendments

These By-Laws may be amended at any annual meeting. They may also be amended at any other meeting of the Section provided that notice is sent to the members in advance of such meeting together with a copy of the proposed amendment or amendments.

---

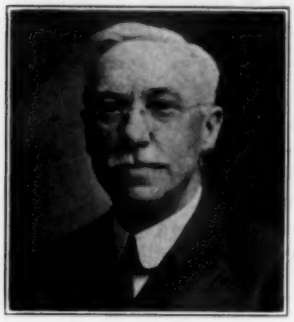
## NOTES AND NEWS

### W. E. Wells for Director U.S. Chamber of Commerce

W. Edwin Wells, East Liverpool, Ohio, has been nominated for Director of the Chamber of Commerce of the United States, representing the Sixth Election District.

Mr. Wells was born on a farm in West Virginia, December 28, 1863. He was graduated from the Steubenville, Ohio School in 1882 and immediately went to work in one

of the Steubenville banks. Later he was bookkeeper for a wholesale drug house and in 1889 came to East Liverpool, Ohio, as a bookkeeper for the Homer Laughlin China Company. This Company was at that time a small concern manufacturing dinnerware, with an annual output of about $70,000.00.



W. E. WELLS

Nine years later Mr. Wells and his associates purchased the Homer Laughlin China Company. Since that time he has been in entire executive control and the Company has had a rapid growth. Its annual output is now $7,000,000, more than twice as great as any other company in the world manufacturing a similar line of ware.

During the past twenty-five years Mr. Wells has been by far the most important figure in the pottery industry in the United States. For all of that time he has served as Chairman of the Labor Committee of the United States Potters Association. It has largely been due to his individual efforts that there has been only one strike, of a few weeks' duration, during that period. This is especially notable since the pottery workers are one of the most strongly unionized groups in the country. He has also been the spokesman for the pottery manufacturers at every hearing held before the House and Senate Committees relative to new tariff bills.

Mr. Wells has always donated generously of his time and money to all civic movements in the East Liverpool District and served throughout the late War as Chairman of the War Chest Committee.

He attended the organization meeting of the National Chamber in 1912 and served on the committee which divided the country into the present election districts. Since then he has attended every annual meeting except one as Councillor for both the East Liverpool Chamber of Commerce and the United States Potters Association. He also attended the organization meeting of the International Chamber at Paris in 1920.

Mr. Wells has the unqualified endorsement of the Directors of the Ohio Chamber of Commerce.

Finally, those of us who know Mr. Wells intimately, and are familiar with his activities over a long number of years, believe that the Chamber of Commerce of the United States could find no one better qualified as a director from the standpoints of ability, integrity and interest in the work.

---

**An Earned Tribute to Charles Lucius Allen, President of Norton Company**

March 6, 1928 was Mr. Allen's seventieth birthday, the fiftieth anniversary of his connection with the Norton Co., and the tenth as its president. So effectively has he served and honored others while always withdrawing from publicity for himself that when someone suggested repaying in part the credit and honor due Mr. Allen on the occasion of his "three score and ten" the idea rapidly spread, and there were many who would gladly have been "in on the celebration." Only a few of his closest friends and associates were at the birthday party given as a surprise to Mr. Allen but many more were represented by telegram and letter, and a still larger number of friends would have sent Mr. Allen their best wishes had they known of the occasion.

To ceramists in America, England, France, and Germany there has come a large indirect benefit from the activities and the managerial skill of Mr. Allen. The scope of his

accomplishments and the breadth of his interests are not known generally because of his extreme modesty. But we would thus record our recognition of him and his services, not alone in partial acknowledgment of our obligations but also to make general the vital inspiration which his life and works are to those who are striving to render similar service.

CHARLES L. ALLEN

The Norton Emery Wheel Co., was incorporated in 1885 with Charles L. Allen as its General Manager. The first building of the company consisted of two stories and a basement, 48 by 120 ft. Only three years after the erection of the first building, two stories and a basement were added and a year later there were further additions including a brick office building. Thus the plant grew, new buildings being added from year to year, until today there are approximately fifty-five buildings containing over a million and three quarters square feet of manufacturing floor space. In going from one extreme of the plant to the other, from Plant 4 in Worcester, Mass. to the storage buildings beyond Plant 6, one must travel a distance of exactly one mile. The number of employees in the present plant is between 2500 and 3000.

In 1901, a plant for the manufacture of the artificial abrasive was built at Niagara Falls, followed soon after by the erection of a plant at Bauxite, Arkansas, where bauxite is mined. In 1902, the first building was erected in Worcester for the manufacture of Norton cylindrical grinding machines under the firm name "Norton Grinding Company." Both the abrasive plants and the grinding machine plant have since had many additions.

In 1909, the first plant was built on foreign soil, when the Deutsche Norton Gesellschaft was organized at Wesseling, near Bez Coln, Germany. The Wesseling plant started operation in 1910. In 1910, a plant was erected at Chippawa, Ontario, Canada, for the manufacture of the abrasive carbide of silicon. A grinding wheel plant was located at Hamilton, Ontario, Canada in 1920. Compagnie Des Meules Norton began operations in France at La Courneuve, near Paris, in 1920.

The Company sales offices and organizations of both Chicago and Detroit are located in Norton buildings and another Norton building is to be built in Philadelphia. Other Norton Sales offices are located in New York, Pittsburgh, Hartford, Cleveland, and Syracuse.

Many products other than abrasive wheels have since been introduced. Norton bench and floor stands were first marketed in 1892. Oil stones were introduced in 1897. Norton cylindrical grinding machines, 1900. Alundum abrasive was first made in 1901, and superseded emery in 1906. The first introduction of Crystolon wheels and other products was in 1910.

In 1910, Norton refractories were added. This line included numerous articles of laboratory ware and heavy refractories for many purposes, as well as cements and porous plates.

Norton floors products first went on the market in 1917, carrying the Norton Company's interests into the architectural and building field.

The abrasive products now include grinding wheels made by five processes, grain for polishing, and a great variety of miscellaneous bricks and sticks. The items of manufacture, when combinations of abrasives, grains, and grades are considered run into hundreds of thousands.

The Norton grinding machine business has grown until there is a total of approximately 100 sizes of the several types.

The history and progress of the City of Worcester, like the history and progress of any other community, is in reality a composite picture of the lives of those whose qualities of heart and head have made them enthusiastic helpers and subsequently admired leaders in community affairs. Charles L. Allen has always been a vital factor in the life of Worcester since the day when he was summoned from his work in the Boston & Maine Railroad office in 1880 to become a member of the group in the old Norton Pottery.

Although the responsibilities of direction of the affairs of the Norton Company have made a heavy claim upon his thought and energy, Mr. Allen has always held himself ready to answer the variety of calls which were bound to come from the community to one who seems so able and so willing to perform. A mere listing of the companies and institutions with which he has been associated almost constitutes a picture of the entire community: Norton Company, Indian Hill Company, Riley Stoker Corporation, the Worcester County National Bank, Bancroft Realty Company, Worcester Merchants Mutual Insurance Company, Norcross Brothers Company, Worcester Five Cents Savings Bank. For many years he has been a Director of the Liberty Mutual Insurance Company of Boston.

Beyond the confines of business, he has been active in many phases of community life. For four years he was a member of Company C, Worcester Light Infantry, Second Regiment, Massachusetts Volunteer Militia, and has continued since to be an enthusiastic member of the Veterans' Association. His interest in outdoor life and farming is disclosed by his Directorship in the Worcester County Farm Bureau and his activity in the Eastern States League. His counsel has been claimed by the Old Men's Home and by the Worcester Polytechnic Institute of which he is a Trustee and a member of the Executive Committee.

The City has honored him by making him a member of the Parks and Recreation Board and subsequently a member of the Commission for a memorial to the Soldiers in the World War. His war service was notable as a member of the Massachusetts Committee of Public Safety, member of the Worcester Committee of Public Safety, member of the War Payroll Committee of the United States Chamber of Commerce, member of the Executive Committee of the National Security League, Trustee of the New England Farm and Food Foundation, President of the War Savings Thousand Dollar Club, and especially to be mentioned was his notably successful chairmanship of the Fourth Liberty Loan Campaign of Worcester.

National honors have come to him through his appointment by President Coolidge as a member of the Hoover Commission upon the St. Lawrence Waterways. He is a member of the American Museum of National History and of the Business Historical Society and the American Society of Mechanical Engineers.

A period of enthusiastic community work has been his association with the Worcester Welfare Federation of which he was one of the founders and upon the Executive Board of which he has served constantly with unremitting faithfulness. Perhaps a little current slang can best express Mr. Allen's place in local affairs. If there is "anything doing" in Worcester for the good of someone somewhere, for the enchantment of Worcester or for the benefit of the commonwealth, in the aid of the nation, Mr. Allen is invariably found in the midst of the "doings."

---

## OBITUARIES

### W. F. Demuth

Dr. William Francis Demuth has passed on. He was president of the National Brick Manufacturers' Association and for years an enthusiastic supporter of the AMERI-

CAN CERAMIC SOCIETY. He organized the Canton Brick and Fireproofing Co., with plants in Canton, Midvale, Robertsville, and Newcomerstown, all in Ohio, and the Georgia White Brick Co. at Gordon, Ga.

W. L. DEMUTH

The personal items regarding Dr. Demuth are instructive. He was graduated from Oberlin College and completed a medical course at Western Reserve in 1910. After completing his interneship he settled in Port Washington, Ohio, to practice medicine and engage in banking having served as president of the Farmers' State Bank. He paid his university expenses by building concrete culverts on contracts during the summer months, thus early learning business methods and labor directing.

During the War he entered the Army Medical Corps and went overseas with the Ninth Brigade of the Fifth Division. On December 21, 1918 he received the Croix de Guerre with palm and citation from Marshall Petain for aid rendered to the civilian population of the French town which had been under violent bombardment.

On returning from the service he soon developed a large medical practice in New Philadelphia, Ohio.

In 1920 he organized the Canton Brick and Fireproofing Co. and rapidly expanded it. He was the representative of that company in the AMERICAN CERAMIC SOCIETY. At the time of his death he had served several years as director of the McKane Tire and Rubber Co., and the Stonecreek Exchange Bank.

Such was the history of the man who had won distinction in medicine, in war service, and in business before he was forty-four years of age. During the forty-four years of his life he accomplished much in material things and won the affection of those with whom he came in contact. It was his love and respect for his fellow beings, his desire to make people happy that won for Dr. Demuth a large circle of very intimate and staunch friends at home and abroad. From Florida, Missouri, Illinois, New England, and New York business and personal friends journeyed to New Philadelphia on April 5 to pay him honor.

Ptomaine poisoning was the cause of the death of this man of large physique and unusual will power. It was a sudden passing from business activities, the difficulties of which he always met cheerfully and successfully.

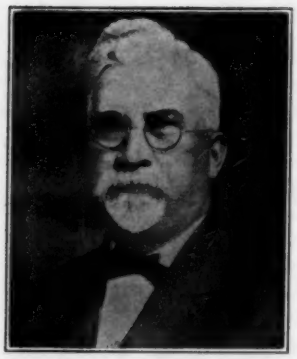
CHARLES W. BROWN

---

**Charles W. Brown**

Charles W. Brown, president of the Pittsburgh Plate Glass Co., died March 6 at his home in Sewickley, Pa., after a stroke of apoplexy which he suffered January 14. He was born in Newburyport, Mass. He entered the glass industry in 1885 in Minneapolis. In 1898 he moved to Pittsburgh and became secretary of the Pittsburgh Plate Glass Co. In 1905 he became vice president, and president in 1916.

### W. A. B. Dalzell



W. A. B. DAZZELL

W. A. B. Dalzell, president of the Fostoria Glass Co., passed away at the age of 70 years after devoting 50 years of his life to the glass industry. He had been connected with the Fostoria Glass Co. since 1901 first as vice president and later as president. Mr. Dalzell has also been a prominent worker in the American Association of Flint and Lime Glass Manufacturers, becoming president of that organization in 1923.

### William Cameron Sproul

William Cameron Sproul, chairman of the board of directors of the General Refractories Co. and former president of the American Refractories Institute, died of pneumonia March 22 after a year's illness. He was ex-governor of Pennsylvania as well as senator.

W. C. SPROUL

### Arthur L. Davidson

Arthur L. Davidson, president of the Crown Potteries Co., died recently at the age of 64. He had been with the company since 1896 in the capacity of salesman, secretary, general manager, and finally president in 1925. He had been a member of the AMERICAN CERAMIC SOCIETY as voter for the Crown Potteries since 1922.

A. L. DAVIDSON

### William Gardner

William Gardner, consulting engineer of Cleveland, Ohio, died of pluro-pneumonia, November 7, 1927. He was a member of the White Wares Division of the AMERICAN CERAMIC SOCIETY since 1921.

## VIEWS OF CERAMIC WORK AT UNIVERSITY OF OKLAHOMA[1]

### John N. Frank, Head of Department

The accompanying pictures show John N. Frank, head of the department of ceramic art at the University of Oklahoma, and his pupils modeling in clay.

Prof. Frank was educated in the Chicago schools, and while in the Art Institute of Chicago assisted with the pottery work under the direction of Mrs. Myrtle Merritt French. He spent the summer of 1927 under Dr. Binns, at the New York State School of Clayworking and Ceramics, Alfred, N. Y.

FIG. 1.—John N. Frank.

[1] For a description of the courses being presented at the University of Oklahoma, see *Bull. Amer. Ceram. Soc.*, **7** [4], 112–13 (1928).

FIG. 2.—Kiln room and drying room.

FIG. 3.—Class at work.

## TORONTO CERAMIC STUDENTS ENTERTAINED[1]

On March 14, a dinner was given by the Canadian National Clay Products Association to the students enrolled in the Ceramic Department, University of Toronto. While the main object of the meeting was to arrange contacts leading to employment of

[1] Robert J. Montgomery, Assistant Prof. of Ceramics.

the students during the summer, it was also a progress report to the Canadian National Clay Products Association as to the growth of the Ceramic Department.

The Association was responsible for the inauguration of the Ceramic Department at the University and agreed to give substantial financial aid for the first three years. This three-year period having ended, a Progress Report was in order.

About twenty-five members were present at the dinner, including, F. B. McFaron, President of the Association, Ryland New, Chairman of the Committee on Education, and Gordon Keith, Secretary of the Association. Eleven students were present, including three third-year men, seven second-year men, and one first-year man. As the students do not indicate their desire to take ceramics until the end of the second year, the number of freshmen interested is uncertain. The local industry is coöperating with the University and all the students will have an opportunity to obtain plant experience this summer.

---

### Fellowships at Missouri School of Mines

In coöperation with the U.S. Bureau of Mines and the State Mining Experiment Station, the School of Mines and Metallurgy of the University of Missouri announces four fellowships. These fellowships are open to graduates who have the equivalent of a Bachelor of Science degree and have had the proper training in mining, metallurgy, or chemistry, and who are qualified to undertake research work. The income of each fellowship is $800 for ten months beginning September 1, 1928. Fellows pay fees amounting to about $42.00 per year.

For 1928–29 the four fellowships will be granted in the following subjects: "Ore Dressing: Problems in Gravity Concentration and Flotation." Applications should be, addressed to the Director, School of Mines and Metallurgy, University of Missouri, Rolla, Mo. up to June 15, 1928.

---

### VITRIFIED PAVING BRICK SCHEDULE REAFFIRMED

Alexander B. Galt, Division of Simplified Practice, Department of Commerce, Washington, D. C. has announced that the Standing Committee has reaffirmed the existing schedule, without change, for one year of Simplified Practice Recommendation, No. 1, Vitrified Paving Brick.

The Committee's rule is to eliminate from the recommendation any variety which for three successive years fails to represent more than $2^1/_2\%$ of the total annual shipments. Similarly, it reinstates any variety which for three years represents more than 5%. Applying this test to the surveys for 1925, 1926, and 1927, it was found that no changes were made in the present list of varieties.

G. F. Schlesinger, Columbus, Ohio, representing the American Association of State Highway Officials, was elected to succeed E. J. Mehren as chairman of the Committee. Others who attended the meeting were E. L. Beller, Natl. Paving Brick Mfgrs. Assn., Chicago, Ill.; R. Keith Compton, A.S.C.E., Richmond, Va.; T. R. Lawson, Amer. Soc. Municipal Improvements, Buffalo, N. Y.; E. E. McCullough, U. S. Chamber of Commerce, Washington, D. C.; O. W. Renkert, AMERICAN CERAMIC SOCIETY, Canton, Ohio; F. L. Manning, Portsmouth, Ohio; and H. R. Colwell, Division of Simplified Practice.

---

### PROPOSED BRICK, TILE, AND HEAVY WARE SECTION OF THE CERAMIC SOCIETY

H. J. C. Johnston, President of the English Ceramic Society, and J. W. Mellor, Honorary Secretary of the same Society have received numerous proposals that a

special "Building Brick, Tile, and Heavy Ware" Section be formed. At present the constitution of this Society includes two main groupings, the Pottery Section and the Refractory Materials Section. Each Section aims to consider the problems and difficulties experienced in the respective branches of manufacture, to stimulate discussion, to publish information relevant to such questions, etc.

The Pottery Section holds monthly meetings between September and May; The Refractory Materials Section two meetings a year at which papers referring to the manufacture or industrial usage of refractories are read. Joint meetings of the two sections are occasionally arranged.

The present proposal is that a third Section of the SOCIETY be formed for the purpose of encouraging the technical development of the heavy-ware industries. It will afford opportunity for the establishment and publication of original scientific data relating to building bricks, roofing tile, pipes, and salt-glazed goods and similar manufactures; and the discussion of questions of importance to such industries.

At the Inaugural Meeting, general arrangements will be discussed and several technical experts will outline the scope for scientific development, increased economy of production, etc., in the particular branches concerned.

---

## AMERICAN CONSTRUCTION COUNCIL TO ISSUE BOOK

By special arrangement with the publishers, the selected proceedings and other papers of the American Construction Council are being issued in regular book form under the title of "Rebuilding America," with a foreword by Franklin D. Roosevelt. The price of this book of about 350 pages will not be over $4.00, C.O.D. The selected papers cover such subjects as "The Reduction of Construction Peaks and Depressions," "Better Building," "City and Town Planning," "Commercial Arbitration," "National Coöperation in the Construction Industry," etc. The American Construction Council is soliciting subscriptions in order to estimate the sale of this book when issued.

---

## SIMPLIFICATION MEETING ON PORCELAIN PLUMBING FIXTURES, MAY 22

A general conference of manufacturers, distributors, and users of staple porcelain (all-clay) plumbing fixtures will be held at the Department of Commerce, Washington, D. C., May 22, 1928, for the purpose of considering a proposed commercial standard for this commodity. A report has been received by Ray M. Hudson, Assistant Director, Commercial Standards Group, Bureau of Standards, from the advisory committee on this commodity, to the effect that the industry believes 87 of the present 622 varieties will be sufficient for regular stock.

---

## THE STEEL SANITARY COMPANY

The Steel Sanitary Company has been organized at Alliance, Ohio, to manufacture a full line of sanitary fixtures made of enameled and stainless sheet steel, including bath tubs, lavatories, sinks, laundry tubs, and other fixtures. The plans contemplate the manufacture at Alliance of 1200 enamel steel and 400 stainless steel sanitary fixtures daily.

This organization is the result of a development by J. C. Cromwell, applying mass production methods of utilizing sheet steel in the sanitary field which is now entirely a cast-iron industry. The officers are W. H. Purcell, Chairman of the Board; F. E. Dussell, President and Treasurer; J. C. Cromwell, General Manager.

## JUNIOR CERAMIC TECHNOLOGIST

The U.S. Civil Service Commission announces the open competitive examination for the position of Junior Ceramic Technologist. The examination is being given to fill vacancies in the Bureau of Standards, Washington, D. C. and in positions requiring similar qualifications, for duty in Washington or in the field. Full information may be obtained from the U.S. Civil Service Commission or the secretary of the U.S. civil service board of examiners at the post office or customhouse in any city.

---

## NOTES FROM THE BUREAU OF STANDARDS

### Ultra-Violet Transmission of Glasses and Glass Substitutes

The number of inquiries which the Bureau has received concerning the ultra-violet transmission of glasses and glass substitutes appears to justify the reprinting of the latest (3rd) edition of *Letter Circ.*, No. 235 on this subject in the *Technical News Bulletin*. The text of this letter circular is as follows:

This letter circular is issued in response to numerous inquiries for information on the transmissive properties of new glasses and organic substitutes for window glass for use in solariums, sun parlors, schools, homes, office buildings, animal houses and greenhouses.

The visible rays of light are comprised between the approximate wave lengths of 760 millimicrons in the red and 400 millimicrons in the violet. Wave lengths longer than 760 millimicrons are called infra-red and those shorter than 400 millimicrons ultra-violet. Though the average eye is not sensitive to wave lengths shorter than 400 millimicrons, such rays actually exist in the light of the sun, extending down to a wave length a little more or a little less than 300 millimicrons, depending on the time of day, season of year, latitude, altitude, and clearness of atmosphere.

Since ordinary window glass shuts out the ultra-violet rays below about 310 millimicrons, much attention has been given of late to the production of special glasses, transparent to the shortest wave lengths which the atmosphere permits the sun to furnish us. This *Letter Circular* gives the results of ultra-violet transmission tests which have been made at the Bureau of Standards upon a number of such special glasses and common window glass.

Total transmission of various glasses for those ultra-violet solar rays to which common window glass is opaque, using a filter method, direct measurements, with sunlight as source, have been made during the noon hours of especially clear days from April to December, 1927.

These measurements covered the solar spectral region to which common window glass is opaque (below about 310 millimicrons). Table I gives for that region the total transmission found for the following specimens:

TABLE I

TOTAL TRANSMISSIONS OF VARIOUS GLASSES WHEN NEW, FOR THE ULTRA-VIOLET SOLAR RAYS TO WHICH COMMON WINDOW GLASS IS OPAQUE

| Trade name | Transmission % | Trade name | Transmission % |
|---|---|---|---|
| Fused quartz | 92 | Cel-o-glass[2] | 20 |
| Corex | 92 | Quartz-lite | 5 |
| Helioglass (Vioray[1]) | 50 | Flexoglass[3] | 1 |
| Vitaglass | 50 | Common window glass | 0–5 |

[1] Vioray is the foreign trade name for Helioglass.
[2] This consists of a fine wire screen whose interstices are covered with cellulose acetate.
[3] This is a loosely woven fabric usually covered with paraffin.

Spectral transmissions of various glasses for the ultra-violet rays: A second and more reliable method of measuring the relative transparency of a specimen of glass to ultra-violet light is to determine its spectral transmission curve, wave length by wave length. Curves of this description are shown in illustration. These curves were obtained by means of an artificial source of light (quartz mercury arc) giving a line spectrum richer in ultra-violet than the solar spectrum.

By means of these spectral transmission curves an estimate of the relative transmissions of the various specimens for rays shut out by common window glass may be obtained by reading from the curves the values of the transmission at 302 millimicrons—the wave length of an intense mercury line of convenient value for making such tests. Table II gives transmission values for this wave length. These are our most recent findings for new specimens.

TABLE II

PER CENT TRANSMISSION OF VARIOUS GLASSES AT 302 MILLIMICRONS WHEN NEW

| Trade name | Number of samples tested | Average thickness mm. | Average transmission at 302 millimicrons % |
|---|---|---|---|
| Fused quartz | 1 | 4.7 | 92 |
| Corex | 4 | 2.8 | 89 |
| Helioglass | 15 | 2.3 | 56 |
| Vitaglass | 15 | 2.5 | 44 |
| Cel-o-glass | 5 | .1* | 30 |
| Quartz-lite | 16 | 1.9 | .5 |
| Common window glass | 14 | 3.3 | .0 |

* About.

Solarization: Helioglass, Vitaglass, and Cel-o-glass have been found to decrease in transmission at 302 millimicrons and neighboring wave lengths (295 to 310 millimicrons) by exposure to ultra-violet radiation from the sun, quartz mercury arc, and carbon arc. The rate of change is much more rapid with the arc than with the sun and varies also with the different glasses.

Vitaglass has been on the market the longest, hence concerning this glass we are able to give the most information on solarization. A sample which had been in a hospital window in Rhode Island for a year was found to have a transmission of 25% at 302 millimicrons (for thickness = 2.3 mm.). Further exposure to the quartz mercury arc reduced the transmission but little, showing that solarization was complete.

Exposure in Washington of a sample ($t = 2.35$ mm.) of Vitaglass directly to the sun for 123 hours (between 9 A.M. and 3 P.M. during June, July, and August) decreased the transmission from 47 to 35%. Our tests show that the greatest decrease in transmission occurs during the first few weeks' exposure. The average transmission of Vitaglass at 302 millimicrons after complete degeneration by the mercury arc is about 25% for a thickness of 2.3 mm.

Helioglass has not been on the market for a sufficient length of time to obtain a complete solarization test. Two samples each of Helioglass and Vitaglass, exposed simultaneously to the sun in October to December, were found to have decreased in transmission to about the same rate. The average transmission of Helioglass at 302 millimicrons, after complete degeneration by the mercury arc, is about 30% for a thickness of 2.3 mm.

Corex glass appears to undergo no appreciable change in transmission when exposed to solar radiation. For example, a sample of cathedral-finish Corex which had been in a greenhouse roof in New York for 14 months was found to have, as nearly as could be measured on that kind of surface, the same transmission as a new sample. It was then polished plane and found to have a transmission of 89.5% at 302 millimicrons, while the average transmission for new samples as given in Table II is 89. On the other hand, exposure to a quartz mercury arc causes very marked decrease in the transmission.

Cel-o-glass (cellulose acetate) becomes opaque at 302 millimicrons and shorter wave lengths after 25 hours' exposure to the quartz mercury arc. A sample that was exposed to the sun for 400 hours during the months of April to October decreased but little in transparency at 302 millimicrons. On the other hand, samples that transmitted 30% at 302 millimicrons when new transmitted only 5 to 10% at this wave length after being exposed on the side of a building continuously day and night for eight months, April to December, showing that the change in transparency may be owing to the varying conditions of the weather.

Quartz-lite is not appreciably affected by sunlight. Exposure to the quartz mercury arc decreases its transmission slightly (measured at 313 millimicrons).

Common window glass is also slightly decreased in transmission by exposure to the quartz mercury arc, but changes inappreciably in sunlight.

Thickness: The thinner the glass, the greater, in general, will be its transparency to ultra-violet rays. Considerations of strength, however, set a limit to an indefinite reduction in thickness. Commercial samples have been submitted for test with a thickness of

less than 1 mm. (1/25 inch). In installing such glass attention should be given to the proper size of sash to meet safety requirements.

A limited number of mimeographed copies of *Letter Circ.*, No. 235, with accompanying chart showing transmission of various window glasses when new, is available at the Bureau of Standards.

Extra copies of this number of the *Tech. News Bull.*, may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents each.

### Preparation of Saggers According to Fundamental Properties of Clays

The seventeen clays and the test data derived from them, which were referred to in the July, 1927 issue of the *Technical News Bulletin*, were made the basis for the preparation of sagger bodies. Fifteen of these clays have been used in a total of 14 combinations of 2 clays each, 1 of high porosity and 1 of lower porosity, consideration also being given to the thermal expansion, transverse strength, and modulus of elasticity. Each combination contained the same percentage of clays and grog and was prepared with both coarse grog and fine grog, resulting in a total of 28 sagger bodies. The grog sizing and percentage of each size were as follows:

| | | Per cent |
|---|---|---|
| Coarse grog | Passed through 4- and retained on an 8-mesh sieve | 20 |
| | Passed through 8- and retained on a 12-mesh sieve | 60 |
| | Passed through 12- and retained on a 20-mesh sieve | 20 |
| Fine grog | Passed through 20- and retained on a 40-mesh sieve | $66^2/_3$ |
| | Passed through 40- and retained on an 80-mesh sieve | $33^1/_3$ |

The 28 sagger bodies may be classified according to composition as follows:

Twenty-six bodies had approximately similar rates of thermal expansion. Four of these bodies contained grog prepared of that clay, in the body, which had the higher porosity, and four contained grog prepared of that clay which had the lower porosity.

Two bodies contained clays chosen on account of the dissimilarity of their rates of thermal expansion.

Six experimental oval saggers, 4 by 4 by 6 by $^1/_2$ inches, were prepared from each of the 28 bodies and fired at 1225°C (cones $8^1/_2$ to $9^1/_2$) for one and one-half hours and were tested for their resistance to thermal shock by air quenching from progressively higher temperatures until fracture occurred. The results of the thermal shock tests indicate that (1) all saggers had failed either previous to or with the quenching at 850°C; (2) the average failure of the bodies, containing the fine grog, occurred at a temperature approximately 100°C lower than the bodies containing the coarse grog; (3) the two bodies, containing the clays having dissimilar rates of thermal expansion, failed at temperatures higher than was anticipated but lower than might be expected in bodies containing clays having similar rates of expansion.

It was found that grog sizing did not appreciably alter the porosity of these sagger bodies, the porosity of the saggers ranging from a minimum of 15 to a maximum of 35%, regardless of whether coarse or fine grog had been used in the body.

### Effect of Surface on Adhesion of Plaster to Tile

In connection with an investigation conducted at the Bureau, data were developed showing the effect of the type of surface on the adhesion of plaster to hollow clay building tile.

Three grades of tile (hard, medium, and soft) were obtained with five types of surfaces (combed, grooved, wire cut, smooth, and glazed). Each of these was plastered with a 1:3 gypsum-sanded plaster, a 1:3 cement-sand stucco, and a 1:3 cement-sand stucco with 10% hydrated lime. The specimens were tested at the age of 28 days and the following results were obtained.

| Tile | Surface | Average adhesion Lbs./in.² |
|---|---|---|
| Hard | Combed | 15.0 |
| | Grooved | 15.6 |
| Medium | Combed | 15.9 |
| | Grooved | 13.2 |
| | Wire cut | 11.9 |
| | Smooth | 10.5 |
| Soft | Combed | 17.1 |
| | Grooved | 9.5 |

In all cases the plaster dropped from the glazed tile under its own weight.

As the only force ordinarily applied to plaster or stucco is its own weight (approximately 0.004 lb./in.² for a $^1/_2$-inch coat), it is evident that the adhesion of plaster or stucco to hollow clay tile of all types is sufficiently great for safety, except in the case of a glazed tile.

A full report of this investigation appeared in the December 20, 1927, issue of the *American Architect*.[2]

### Cast Iron For Enameling Purposes

The program of enameling different irons under various conditions, both at the Bureau and in the laboratories of two plants, which was mentioned in an item on this subject appearing in the *Technical News Bulletin* for August, 1927 (No. 124), has been completed. Differences in the blistering tendencies of the different sets of castings are not so apparent in the case of the high lead enamel, but can readily be seen in the case of the higher fired, wet process enamel which was supplied to the Bureau for use in this work.

Two irons were used, designated as *L* and *R*. Although, on the whole, there were more blisters obtained with the *L* than with the *R* castings, yet the blistering tendencies of the castings were most consistent within the individual heats of either iron. Thus, four heats of each of these irons were made for this series of tests, and heat 4 of iron *L* showed distinctly less blistering tendency than the other three heats of the same iron. Similarly, heat 1 of the iron *R* was not as satisfactory as heats 2 and 3 of this iron. These variations may be due to irregularities in the pig iron, melting conditions, or pouring conditions, although the last two conditions were under better control than is commercially practicable.

Some interesting relationships have been found to exist in the blistering tendencies of these various sets of castings. When a surface layer of iron is removed from any of the castings studied—even those most prone to give blisters—the blistering tendency disappears. This surface layer may be removed by machining, pickling under certain conditions, or sufficiently extended sand blasting, with equally beneficial results. Data are being obtained which should indicate whether the improvement can be attributed to bodily removal of blister-producing material in the surface layer of iron or to some other cause.

A special sand-blast apparatus is in use which is capable of delivering a definite amount of sand or other abrasive at a controlled pressure. Preliminary results obtained with this apparatus indicate that those castings which have more tendency to produce blisters under ordinary conditions lose weight less readily under a given sand-blast treatment.

---

[2] "Adhesion of Plaster and Stucco to Hollow Clay Building Tile," J. A. Murray and H. D. Foster. *The American Architect*, p. 839, December 20, 1927.

## PROGRAM FOR CANADIAN N.C.P. ASSN.

The 26th Annual Convention of the Canadian National Clay Products Association will be held at Montreal June 13, 14, and 15, 1928. On Wednesday, June 13, there will be registration and a reception with other entertainment for the evening.

June 14: 10 A.M. (1) Address of welcome; (2) appointment of committees; (3) president's address; (4) secretary's report; and (5) papers and addresses
2 P.M. Papers and addresses and visits to points of interest
6:30 P.M. Banquet
June 15: 10 P.M. Papers and addresses
12 Noon Luncheon
2 P.M. (1) Reports of committees; (2) round table discussion; and (3) visits to places of interest
6:30 P.M. Leave for the Saguenay

F. B. McFarren is president of this organization, Gordon C. Keith, is secretary, and A. T. Alexander, is chairman of the Montreal Committee. The officers are arranging to welcome many American guests who have already indicated their intention of attending this meeting. Every member of the AMERICAN CERAMIC SOCIETY is especially urged to visit Montreal at this time.

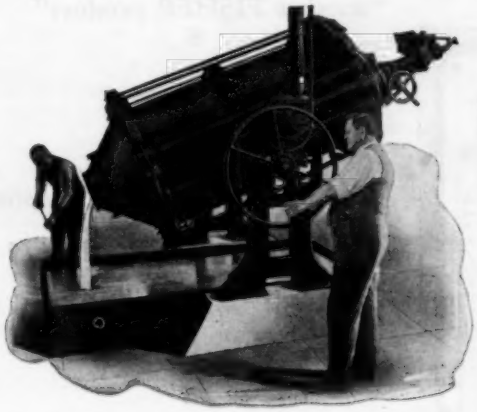
---

## CALENDAR OF CONVENTIONS

| | | |
|---|---|---|
| **AMERICAN CERAMIC SOCIETY** | | |
| **Annual Meeting** | Feb. 1929 | Chicago, Ill. |
| **Ceramists' Tour Abroad** | May 19–July 5 | |
| **American Electrochemical Society** | | |
| **(Fall Meeting)** | Sept. 20–22 | Charleston, W. Va. |
| **Amer. Foundrymen's Assn.** | May 14–18 | Philadelphia, Pa. |
| **Amer. Gas Assn. (Natural Gas Dept.)** | May | Dallas, Texas |
| **Amer. Institute of Architects** | May 9–11 | St. Louis, Mo. |
| **Amer. Refractories Inst.** | May 8–9 | White Sulphur Springs, W. Va. |
| **Amer. Soc. Mechanical Engineers** | | |
| **(Spring Meeting)** | May 14–17 | Pittsburgh, Pa. |
| **(Regional)** | Aug. 27–29 | St. Paul-Minneapolis |
| **(Regional)** | Oct. 1–3 | Boston, Mass. |
| **Amer. Soc. Steel Treating** | | |
| **(Annual Meeting)** | Oct. 8–13 | Philadelphia, Pa. |
| **Assn. of Sci. App. Makers of Amer.** | May 5–7 | Atlantic City, N. J. |
| **Canadian Natl. Clay Products Assn.** | June 13–15 | Montreal, Quebec |
| **Mfg. Chemists Assn. of U. S.** | June 2 | New York City |
| **Natl. Assn. of Mfgrs.** | October | |
| **Natl. Assn. Mfgrs. Heating and Cooking Appliances** | May 9–10 | Detroit, Mich. |
| **Natl. Lime Assn.** | May 23–24 | New York City |
| **Optical Soc. of Amer.** | October | Washington, D. C. |
| **Safety Congress** | Oct. 1–5 | New York City |

**U. S. Rotary Enamel Smelting Furnaces Give**

# *SATISFACTION*



**Excellent Results Best Demonstrated by Large Number of Repeat Orders**

Crane Enamelware Company, Chattanooga, Tennessee.
Kohler Company, Kohler, Wisconsin.
Porcelain Enamel & Mfg. Company, Baltimore, Md.
Ingram-Richardson Mfg. Company, Frankfort, Ind.
Ingram-Richardson Mfg. Company, Beaver Falls, Pa.
Ingram-Richardson Corporation, Bayonne, N. J.
Grand Rapids Refrigerator Co., Grand Rapids, Mich.
Columbian Enameling & Stamping Co., Terre Haute, Ind.
Sheet Metal Products Company, Toronto, Canada.
Republic Metalware Company, Buffalo, N. Y.
Pacific Sanitary Mfg. Company, Richmond, California.
A. Weiskittel & Son Company, Baltimore, Md.
Malleable Iron Range Company, Beaver Dam, Wis.
Edison Electric Appliance Co., Inc., Chicago, Ill.
Welsh Tinplate & Metal Stpg. Co., Ltd., Llanelly, England.
Ernest Stevens, Limited, Cradley Heath, England.
Ward Leonard Electric Company, Mount Vernon, N. Y.
American Enameled Products Co., Chicago, Ill.
Michigan Porcelain Tile Works, Ionia, Michigan.
Stanley Insulating Company, Great Barrington, Mass.
Roesch Enamel Range Company, Belleville, Ill.
L. D. Caulk Company, Milford, Delaware.

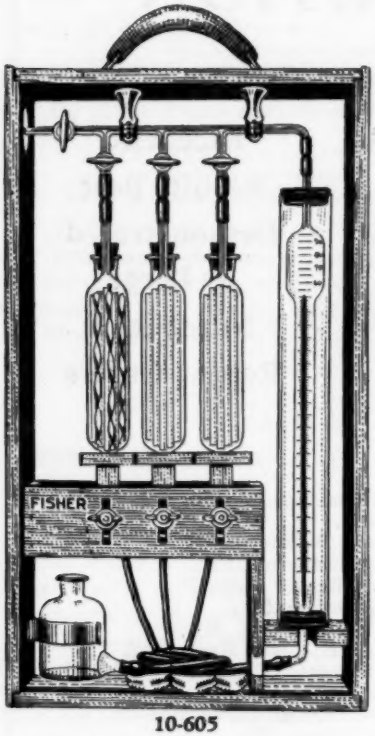
SIZES AND CAPACITIES

| No. 1 | No. 2 | No. 3 | No. 4 | No. 4-B |
|---|---|---|---|---|
| 60 lb. | 150 lb. | 350 lb. | 750 lb. | 1200 lb. |

*Description, Photographs, Specifications and Prices Mailed Promptly*

**THE U. S. SMELTING FURNACE CO.**
BELLEVILLE, ILLINOIS, U. S. A.

# FISHER FLUE GAS ANALYZER




10-605

"another FISHER product"

*The apparatus which supplies the information necessary to efficient combustion*

*Efficient combustion will effect a substantial saving in the fuel bill*

Simple and rugged in its construction, this flue-gas analyzer is the ideal equipment for the determination of carbon dioxide, carbon monoxide and oxygen.

The three pipettes are mounted on shelves which facilitate their cleaning.

The rubber apparatus connections are of gas-tight acid cured **SCIMATCO** Tubing.

The burette can be directly read in per cent and has a capacity of 100 cc. Price $98.00.

**FISHER SCIENTIFIC COMPANY**

*Laboratory Apparatus and Reagents for Chemistry, Metallurgy, Biology*

PITTSBURGH, PA.

IN CANADA, FISHER SCIENTIFIC CO. LTD., 472 MCGILL ST., MONTREAL

## BUYERS' GUIDE

### A

**Air Reducing Valves**
Fisher Governor Co.

**Air Traps**
Fisher Governor Co.

**Alumina (Hydrate and Calcined)**
Harshaw, Fuller & Goodwin Co.
Pennsylvania Salt Mfg. Co.
Roessler and Hasslacher Chemical Co.

**Aluminum Oxide (fused)**
The Exolon Co.

**Aloxite (Refractory Products)**
The Carborundum Co.

**Alundum (Refractory Products)**
Norton Co.

**Antimony Oxide**
Roessler & Hasslacher Chemical Co.

**Auger Machines**
Chambers Brothers Co.

**Automatic Control Valves**
Maxon Premix Burner Co.

**Automatic Cutters**
Chambers Brothers Co.

**Automatic Stove Rooms**
Philadelphia Drying Machinery Co.

**Automatic Temperature Control**
Brown Instrument Co.
Leeds & Northrup Co.

### B

**Back Pressure Valves**
Fisher Governor Co.

**Ball Mills (Laboratory Type)**
Abbé, Paul O.
Fisher Scientific Co.

**Ball Mills**
Abbé, Paul O.
McDaniel Refrac. Porcelain Co.
Mueller Machine Co., Inc.

**Barium Carbonate**
Roessler & Hasslacher Chemical Co.

**Batts**
The Carborundum Co. *("Carbofrax Aloxite")*
Norton Co. *("Alundum-Crystolon")*

**Bitstone**
Eureka Flint & Spar Co.
Golding Sons Company
Potters Supply Co.

**Blocks (Refractory)**
The Carborundum Co.
Norton Co.

**Blowers**
Jeffrey Mfg. Co.

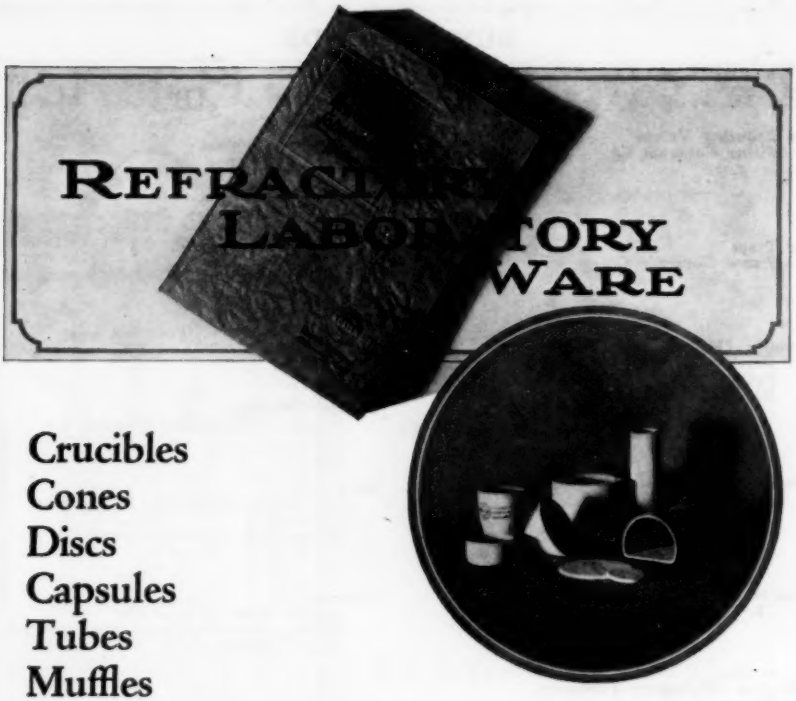
**Blowers (centrifugal—high pressure)**
Maxon Premix Burner Co. *(Premix)*

**Boats, Combustion**
Fisher Scientific Co.
Norton Co.

**Boiler Feeders**
Fisher Governor Co.

**Borax**
American Potash & Chemical Co.
Drakenfeld & Co., B. F.
Innis, Speiden & Co.
Pacific Coast Borax Co.
Roessler & Hasslacher Chemical Co.

**Boric Acid (Anhydrous)**
Pacific Coast Borax Co.




**Crucibles**
**Cones**
**Discs**
**Capsules**
**Tubes**
**Muffles**

If you are using refractory laboratory ware for incineration, filtration, extraction, or heat treatment you should be familiar with Alundum and Crystolon equipment.

These Norton products and their uses are described in detail in a catalog which will be sent upon request.

A booklet regarding the use of Alundum Tubes in the manufacture of laboratory electric furnaces may also be had for the asking.

**NORTON COMPANY**
**Worcester, Mass.**
**New York** **Chicago**
**Cleveland**

R-327

**NORTON**
REFRACTORIES

*(When writing to advertisers, please mention the JOURNAL)*

## BUYERS' GUIDE (continued)

**Boric Acid (Crystal, Granular or Powder)**
American Potash & Chemical Co.
Drakenfeld & Co., B. F.
Innis Speiden & Co.
**Pacific Coast Borax Co.**

**Borax Glass**
**Pacific Coast Borax Co.**

**Brick Making Machinery**
Chambers Brothers Co.

**Bricks (Refractory)**
The Carborundum Co. *("Carbofrax Aloxite")*
**Harbison Walker Refractories Co.**
Norton Co. *("Alundum-Crystolon")*

**Bucket Elevators**
Jeffrey Mfg. Co.

**Burners (Gas—Oil)**
Maxon Premix Burner Co.

**Burners (Combination Oil and Gas)**
Maxon Premix Burner Co.

## C

**Carbofrax (Refractory Products)**
The Carborundum Co.

**Carbolon (Refractory Products)**
The Exolon Co.

**Carbonates (Barium-Lead)**
Innis, Speiden & Co.
**Roessler & Hasslacher Chemical Co.**

**Caustic Soda**
Pennsylvania Salt Mfg. Co.

**Cements**
Corundite Refractories Co.
**Harbison Walker Refractories Co.**
Norton Co.
**The Carborundum Co.**

**Ceramic Chemicals**
**Drakenfeld and Co., B. F.**
**Harshaw, Fuller & Goodwin Co.**
**Metal & Thermit Corp.**
**Roessler and Hasslacher Chemical Co.**
**Titanium Alloy Mfg. Co.**
**Vitro Mfg. Co.**
**Harbison Walker Refractories Co.**

**Ceramic Plant Equipment**
**Chambers Brothers Co.**
**Harrop Ceramic Service Co.**
**Jeffrey Mfg. Co.**
**Mueller Machine Co., Inc.**
**Philadelphia Drying Machinery Co.**
**Proctor and Schwartz, Inc.**

**Chains**
**Jeffrey Mfg. Co.**

**Chemicals (Analytical)**
Fisher Scientific Co.

**Chromium Oxide**
**Roessler & Hasslacher Chemical Co.**

**China Clay (Georgia)**
Golding Sons Company

**Clay (Ball)**
Golding Sons Company
**Harshaw, Fuller & Goodwin Co.**
**Kentucky-Tennessee Clay Co.**
**Old Hickory Clay & Talc Co.**
**Potters Supply Co.**
**Roessler & Hasslacher Chemical Co.**
**Spinks Clay Co., H. C.**
**United Clay Mines Corp.**

**Clay (China)**
**Drakenfeld and Co., B. F.**
**Edgar Brothers Co.**
**English China Clay Sales Corp.**
**Harshaw, Fuller & Goodwin Co.**
**Roessler and Hasslacher Chemical Co.**
**United Clay Mines Corp.**

**Clay (Electrical—Porcelain)**
**Edgar Brothers Co.**
**English China Clay Sales Corp.**
**Harshaw, Fuller & Goodwin Co.**
**Kentucky-Tennessee Clay Co.**
**Old Hickory Clay & Talc Co.**
**Spinks Clay Co., H. C.**
**United Clay Mines Corp.**

**Clay (Enamel)**
**Edgar Brothers Co.**
**Kentucky-Tennessee Clay Co.**
**Metal & Thermit Corp.**
**Roessler & Hasslacher Chemical Co.**
**United Clay Mines Corp.**
**Vitro Mfg. Co.**

**Clay (Fire)**
Corundite Refractories Co.
**Edgar Brothers Co.**
**Harbison Walker Refractories Co.**
**Kentucky-Tennessee Clay Co.**
**Potters Supply Co.**
**United Clay Mines Corp.**

**Clay (Potters)**
**English China Clay Sales Corp.**
**Old Hickory Clay & Talc Co.**
**Roessler & Hasslacher Chemical Co.**
**Spinks Clay Co., H. C.**
**United Clay Mines Corp.**

**Clay (Sagger)**
**Edgar Brothers Co.**
**English China Clay Sales Corp.**
**Harbison Walker Refractories Co.**
**Kentucky-Tennessee Clay Co.**
**Old Hickory Clay & Talc Co.**
**Potters Supply Co.**
**Spinks Clay Co., H. C.**
**United Clay Mines Corp.**

# The National Silica Co.

**OREGON, ILL.**

***Producers and Pulverizers of***

# FLINT

***exclusively for***

## Pottery Purposes

**99.97% Pure Silica** **140 Silk Lawn Test**

# SERVICE TO POTTERS

We Manufacture—

- PINS
- STILTS
- THIMBLES
- SPURS
- SAGGERS
- CRUCIBLES
- TILE for Decorating Kilns

We Sell—

- BALL CLAY
- SAGGER CLAY
- WAD CLAY
- GROUND FIRE CLAY
- BITSTONE
- FIRE BRICK
- IMPORTED PARIS WHITE
- DOMESTIC WHITING

## THE POTTERS SUPPLY COMPANY

**EAST LIVERPOOL, OHIO**

*(When writing to advertisers, please mention the JOURNAL)*

## BUYERS' GUIDE (continued)

**Clay (Stoneware)**
United Clay Mines Corp.

**Clay Tests**
Harrop Ceramic Service Co.

**Clay (Terra Cotta)**
United Clay Mines Corp.

**Clay Handling Machinery**
Jeffrey Mfg. Co.
Mueller Machine Co. (Inc.)
W. S. Tyler Co.

**Clay Miners**
Edgar Brothers Co.
English China Clay Sales Corp.
Kentucky-Tennessee Clay Co.
Old Hickory Clay & Talc Co.
Spinks Clay Co., H. C.
United Clay Mines Corp.

**Clay Storage Systems**
Jeffrey Mfg. Co.

**Clay (German Vallendar)**
Roessler & Hasslacher Chemical Co.

**Clay (Wad)**
Kentucky-Tennessee Clay Co.
Potters Supply Co.
Spinks Clay Co., H. C.
United Clay Mines Corp.

**Clay (Wall Tile)**
English China Clay Sales Corp.
Kentucky-Tennessee Clay Co.
Old Hickory Clay & Talc Co.
Spinks Clay Co., H. C.
United Clay Mines Corp.

**Clay Washing Machinery**
Mueller Machine Co., Inc.

**Clay Working Machinery**
Mueller Machine Co., Inc.

**Cloth (Wire Bolting)**
W. S. Tyler Co.

**Coal & Ash Handling Mchy.**
Jeffrey Mfg. Co.

**Cobalt Oxide**
Drakenfeld and Co., B. F.
Roessler & Hasslacher Chemical Co.

**Colors**
Drakenfeld and Co., B. F.
Harshaw, Fuller & Goodwin Co.
Innis, Speiden & Co.
Roessler and Hasslacher Chemical Co.
Vitro Mfg. Co.

**Combustion Apparatus**
Jeffrey Mfg. Co.
Fisher Scientific Co.

**Conditioning Machinery**
Philadelphia Drying Machinery Co.
Proctor & Schwartz, Inc.

**Cones (Filter)**
Fisher Scientific Co.
Norton Co.

**Conveyors (Belt Cable)**
Jeffrey Mfg. Co.

**Conveyors (Clay, Sand, Brick, etc.)**
Jeffrey Mfg. Co.
Mueller Machine Co., Inc.
Philadelphia Drying Machinery Co.

**Conveyors (portable)**
Jeffrey Mfg. Co.

**Controllers**
Brown Instrument Co.
Engelhard, Chas., Inc.
Leeds & Northrup Co.

**Cores (Alundum Furnace)**
Norton Co.

**Cornwall Stone**
English China Clay Sales Corp.
Eureka Flint & Spar Co.
Harshaw, Fuller & Goodwin Co.
Pennsylvania Pulverizing Co.
Roessler and Hasslacher Chemical Co.

**Cornwall Stone (Imported)**
Golding Sons Company

**Crucibles (Filter-Melting-Ignition)**
Norton Co.
Potters Supply Co.

**Crushers**
Chambers Brothers Co.
Jeffrey Mfg. Co.
Mueller Machine Co., Inc.

**Cryolite**
Roessler & Hasslacher Chemical Co.

## D

**Decorating Supplies**
Drakenfeld and Co., B. F.
Roessler and Hasslacher Chemical Co.
Vitro Mfg. Co.

**Discs (Alundum-Porous-Filter)**
Norton Co.

*Don't Forget!* — **FERRO BURNING POINTS AND BARS ARE BETTER**

Better Metal — Better Castings — Better Designs
Better Service — Better Prices

See our Standard Patterns in our Burning Bar Booklet.
Write for it today—it's free.

**THE FERRO ENAMEL SUPPLY CO.**
2100 B. F. Keith Building CLEVELAND, OHIO

**PENNSYLVANIA SALT MANUFACTURING COMPANY**

Executive Offices: Philadelphia, Pa.

Works: Philadelphia and Natrona, Pa., Wyandotte and Menominee, Mich.

Representatives:
New York Chicago
Pittsburgh St. Louis

PENNA. SALT MANUF'G. CO.
PURE
GREENLAND KRYOLITH
PHILADELPHIA, PA

**THREE ELEPHANT BORAX**

***99.5% Pure***

We also make Boric Acid, guaranteed 99.5% pure

*Write us for specification and price*

**American Potash-Chemical Corporation**
WOOLWORTH BLDG. NEW YORK CITY

Suppose all we young fellows swore off shaving for life—what a fine looking race we'd be. But you have got to hand it to whiskers, they are the nearest thing to perpetual motion we have, month in and month out—never failing us for even a day.

A lot of Ceramic manufacturers feel the same way about

**EDGAR CLAYS**

using them year after year because they are assured of QUALITY, UNIFORMITY and PRICE. Another thing, they are always as represented.

## BUYERS' GUIDE (continued)

**Dishes (Alundum-Filtering-Ignition)**
Norton Co.

**Disintegrators**
Chambers Brothers Co.
Mueller Machine Co., Inc.

**Dolomite**
Innis, Speiden & Co.

**Driers**
Harrop Ceramic Service Co.

**Dryers (China Ware—Porcelain)**
Philadelphia Drying Machinery Co.
Proctor & Schwartz, Inc.

**Drying Machinery**
Philadelphia Drying Machinery Co.
Proctor & Schwartz, Inc.

### E

**Electrical Instruments**
Brown Instrument Co.
Leeds & Northrup Co.

**Electrical Porcelain Machinery**
Mueller Machine Co., Inc.

**Elevators (Bucket, tray, arm)**
Jeffrey Mfg. Co.

**Enamels**
Roessler & Hasslacher Chemical Co.

**Enameling Equipment, Complete**
Chicago Vitreous Enamel Product Co.
Ferro Enamel Supply Co.

**Enameling Furnaces**
Chicago Vitreous Enamel Product Co.
Corundite Refractories Co.
Ferro Enamel Supply Co.
The Carborundum Co. *(Carboradiant)*
U. S. Smelting Furnace Co.
Vitro Mfg. Co.

**Enameling Muffles**
The Carborundum Co. *(Carbofrax)*

**Enameling, Practical Service**
Chicago Vitreous Enamel Product Co.
Ferro Enamel Supply Co.
Vitro Mfg. Co.

**Enamels, Porcelain**
Chicago Vitreous Enamel Product Co.
Ferro Enamel Supply Co.
Vitro Mfg. Co.

**Engineering Service**
Chambers Brothers Co.
Harrop Ceramic Service Co.

**Equipment (Porcelain Enameling)**
Chicago Vitreous Enamel Product Co.
Ferro Enamel Supply Co.

**Exhaust Relief Valves**
Fisher Governor Co.

**Exolon (Refractory Products)**
The Exolon Co.

**Extruding Machines (Lab. Use)**
Chambers Brothers Co.

### F

**Fans**
Jeffrey Mfg. Co.
Philadelphia Drying Machinery Co.

**Feldspar**
Eureka Flint & Spar Co.
Genesee Feldspar Co.
Harshaw, Fuller and Goodwin Co.
Innis, Speiden & Co. *(Isco)*
Pennsylvania Pulverizing Co.
River Feldspar Co.
Roessler and Hasslacher Chemical Co.

**Filter Cloth (Wire)**
W. S. Tyler Co.

**Filtering Machinery**
Mueller Machine Co., Inc.

**Fire Brick**
Corundite Refractories Co.
The Carborundum Co.
Harbison Walker Refractories Co.

**Flint**
Eureka Flint & Spar Co.
Harshaw, Fuller and Goodwin Co.
Innis, Speiden & Co. *(Carrara)*
National Silica Co.
Pennsylvania Pulverizing Co.
Roessler and Hasslacher Chemical Co.

**Flint (American Sand and Rock)**
Golding Sons Company

**Flint (Imported Pure)**
Golding Sons Company

**Flint Pebbles**
Eureka Flint & Spar Co.
Roessler & Hasslacher Chemical Co.

**Flow Meters**
Brown Instrument Co.

# CLAY MACHINERY!

| SAGGER ROOM | SLIP HOUSE | GRINDING ROOM |
|---|---|---|
| Grog Pans | Blungers | Clay Crackers |
| Pug Mills | Agitators | Pulverizers |
| Sagger Presses | Lawns | Cage Grinders |
| Wad Mills | Pumps | Dust Screens |
| Grog Screens | Filter Presses | Pebble Mills |
| **PRESS ROOM** | **GREEN ROOM** | **GLAZE ROOM** |
| Tile Presses | Jiggers | Glaze Mills |
| Faience Presses | Pull Downs | Agitators |
| Porcelain Presses | Cleaning Wheels | Lawns |
| Dies & Equipment | Batting Machines | Pumps |

**THE MUELLER MACHINE CO.**
TRENTON, N. J.

TRADE MARK

**Pyrometer Tubes—Protection Tubes—Combustion Tubes**
**McDanel Refractory Porcelain Company**
**Beaver Falls, Pennsylvania**

**UNUSUAL · SHAPES · OUR · SPECIALTY**

## The Journal of the Society of Glass Technology

A quarterly Journal containing original papers and abstracts of papers covering the whole field of Glass Technology.

ANNUAL SUBSCRIPTIONS TO SOCIETY (Including Journal)

| | |
|---|---|
| Ordinary Members | $ 7.00 |
| Collective Members | 15.00 |
| Price per Number to non-Members | 2.50 |
| Price per Volume (unbound) to non-Members | 9.00 |

Forms of application for membership may be obtained from the American Treasurer of the Society, Mr. Wm. M. Clark, Ph.B., Nela Park, Cleveland, Ohio.

Address orders and inquiries to: The Secretary, Society of Glass Technology, The University, Sheffield, England.

THE CERAMIC STANDARDS BOOK
WILL APPEAR IN JUNE
ISSUE.

*(When writing to advertisers, please mention the JOURNAL)*

## BUYERS' GUIDE (continued)

**Frit**
Vitro Mfg. Co.

**Furnace Conveyors**
Jeffrey Mfg. Co.

**Furnaces**
Chicago Vitreous Enamel Product Co.
Corundite Refractories Co.
Ferro Enamel Supply Co.
The Carborundum Co. *(Carboradiant)*
Harrop Ceramic Service Co.
U. S. Smelting Furnace Co

**Furnaces (Crucible—Lead—Pot)**
Maxon Premix Burner Co.

**Furnaces (Electrical, Laboratory Type)**
Chas. Engelhard, Inc.
Fisher Scientific Co.

**Furnaces (Melting)**
Maxon Premix Burner Co.

**Furnace Slabs**
Corundite Refractories Co.

## G

**Gates (Blast)**
Maxon Premix Burner Co.

**Glazes and Enamels**
Chicago Vitreous Enamel Product Co.
Drakenfeld & Co., B. F.
Ferro Enamel Supply Co.
Harshaw, Fuller and Goodwin Co.
Roessler and Hasslacher Chemical Co
Vitro Mfg. Co.

**Glaze and Body Spar**
Golding Sons Company

**Glaze Spar**
Eureka Flint & Spar Co.
Roessler & Hasslacher Chemical Co.

**Gold**
Drakenfeld & Co., B. F.
Harshaw, Fuller and Goodwin Co.
Roessler and Hasslacher Chemical Co.
Vitro Mfg. Co.

**Guards (Safety)**
W. S. Tyler Co.

## H

**Hearths**
The Carborundum Co.
(*Carbofrax* heat treating)

**Hearths (High Aluminous Clay—Electrically Sintered Aluminum Oxide—Silicon Carbide)**
The Carborundum Co.

**Heaters (Air-Oil)**
Maxon Premix Burner Co.

**Humidity Control**
Brown Instrument Co.

**Hydrogen Ion Equipment**
La Motte Chem. Products Co.

**Hygrometers**
Brown Instrument Co.

## I

**Indicators & Recorders (Steam, Air, Gas)**
Engelhard, Chas., Inc.

**Indicators, Chemical**
La Motte Chem. Products Co.

**Infusorial Earth**
Innis, Speiden & Co.
Harrop Ceramic Service Co.

**Instruments (Temperature, Pressure)**
Brown Instrument Co.

**Iron (Enameling)**
American Rolling Mill Co.

## J

**Jiggers**
Mueller Machine Co., Inc.

## K

**Kaolin**
Edgar Brothers Co.
English China Clay Sales Corp.
Harshaw, Fuller & Goodwin Co.
Roessler and Hasslacher Chemical Co.
United Clay Mines Corp.

**Kaolin (Delaware)**
Golding Sons Company

**Kilns**
Harrop Ceramic Service Co.

**Kilns (China, Decorating)**
Drakenfeld & Co., B. F.

**Kryolith**
Harshaw, Fuller & Goodwin Co.
Pennsylvania Salt Mfg. Co.
Roessler and Hasslacher Chemical Co.

*(When writing to advertisers, please mention the JOURNAL)*

Specialists since 1869 in

# METAL OXIDES

| | |
|---|---|
| COBALT | TIN |
| CHROME | ANTIMONY |
| COPPER | MANGANESE |
| NICKEL | URANIUM |

## SELENIUM
## SODIUM SELENITE
## CADMIUM SULPHIDE

Red—Orange—Yellow

## GLOBE
## DECOLORIZING COMPOUNDS

## COBALT SULPHATE
## COBALT OXIDE

POWDER BLUE ZAFFRE

## B. F. DRAKENFELD & CO. Inc.

Established 1869

45-47 Park Place New York

*(When writing to advertisers, please mention the JOURNAL)*

## BUYERS' GUIDE (continued)

### L

**Laboratory Supplies**
Fisher Scientific Co.
W. S. Tyler Co.

**Lawn**
W. S. Tyler Co.

**Lehrs (High Aluminous Clay—Electrically Sintered Aluminum Oxide—Silicon Carbide)**
The Carborundum Co.
Jeffrey Mfg. Co.

**Linings (Furnace-Refractory, Block Refractory Plate, Brick and Tile)**
Corundite Refractories Co.
Harbison Walker Refractories Co.
Norton Co.
The Carborundum Co.

**Liquid Level Indicator and Recorder**
Brown Instrument Co.
Fisher Governor Co.

**Loaders (portable)**
Jeffrey Mfg. Co.

### M

**Magnesia (sintered) (calcined)**
The Exolon Co.
Harbison Walker Refractories Co.
Roessler & Hasslacher Chemical Co.

**Magnesite**
Drakenfeld & Co., B. F.
Harbison Walker Refractories Co.
Harshaw, Fuller & Goodwin Co.
Innis, Speiden & Co.
Roessler & Hasslacher Chemical Co.

**Manometers**
Brown Instrument Co.

**Manganese**
Drakenfeld & Co., B. F.
Harshaw, Fuller & Goodwin Co.
Roessler and Hasslacher Chemical Co.

**Metals (Porcelain Enameling)**
American Rolling Mill Co.

**Meters (All Kinds)**
Engelhard, Chas., Inc.

**Minerals**
Drakenfeld & Co., B. F.
Harshaw, Fuller & Goodwin Co.
Roessler and Hasslacher Chemical Co.
Vitro Mfg. Co.

**Mixing Machines**
Chambers Brothers Co.

**Motors**
Harrop Ceramic Service Co.

**Muffles (Furnace)**
Corundite Refractories Co.
Norton Co.
The Carborundum Co. *(Carbofrax)*

**Multistage Compressors**
Maxon Premix Burner Co.

**Mullite (artificial)**
The Exolon Co.

**Muriatic Acid**
Harshaw, Fuller & Goodwin Co.
Pennsylvania Salt Mfg. Co.
Roessler and Hasslacher Chemical Co.

### N

**Nitrates (Cobalt, Sodium)**
Harshaw, Fuller & Goodwin Co.
Innis, Speiden & Co.
Roessler & Hasslacher Chemical Co.

### O

**Oil Burning Systems**
Maxon Premix Burner Co.

**Opacifiers**
Harshaw, Fuller & Goodwin Co.
Titanium Alloy Mfg. Co.

**Orifice Plates**
Brown Instrument Co.

**Oxides**
Drakenfeld & Co., B. F.
Harshaw, Fuller & Goodwin Co.
Innis, Speiden & Co.
Metal & Thermit Corp.
Pennsylvania Salt Mfg. Co.
Roessler and Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
Vitro Mfg. Co.

*(When writing to advertisers, please mention the JOURNAL)*

**BORAX** *Guaranteed 99½%-100% Pure* **BORIC ACID**

**Select the Brand which has back of it years of *successful use* by experienced Ceramists.**

**Pacific Coast Borax Co., New York**

Chicago Los Angeles

**RIVER FELDSPAR**

**Ground to Your Specifications up to 325 mesh.**

***A High Grade, Uniform, White***

**POTASH FELDSPAR**

**THE RIVER FELDSPAR CO., Middletown, Conn.**

GEO. E. WORTH, *General Manager*

# Refractory Materials

***Products of the Electric Furnace***

SILICON CARBIDE
SILICON CARBIDE FIRESAND
FUSED SILICA
ARTIFICIAL MULLITE
FUSED ALUMINUM OXIDE
FUSED MAGNESITE

**Furnished in raw material form, ground to meet specifications.**

**Our Research Department with fully equipped laboratories is always at your service.**

**WRITE US ABOUT YOUR PROBLEMS**

## THE EXOLON COMPANY

**Established 1914**

**Electric Furnace Plants** { THOROLD, ONTARIO / STAMFORD, ONTARIO

**Finishing Plant / General Offices** { BLASDELL, N. Y.

## BUYERS' GUIDE (continued)

### P

**Pans (Wet and Dry)**
Chambers Brothers Co.
Mueller Machine Co., Inc.

**Pebble Mills**
Abbé, Paul O.
Mueller Machine Co., Inc.

**Pins**
Potters Supply Co.

**Placing Sand**
Eureka Flint & Spar Co.
National Silica Co.
Pennsylvania Pulverizing Co.
Roessler & Hasslacher Chemical Co.
United Clay Mines Corp.

**Plant Design**
Harrop Ceramic Service Co.

**Plate Feeders**
Chambers Brothers Co.
Jeffrey Mfg. Co.

**Plate (Filter)**
Norton Co.

**Porcelain Enameling Service, Practical**
Chicago Vitreous Enamel Product Co.
Ferro Enamel Supply Co.
Vitro Mfg. Co.

**Porcelain Enamels**
Chicago Vitreous Enamel Product Co.
Ferro Enamel Supply Co.
Roessler & Hasslacher Chemical Co.
Vitro Mfg. Co.

**Potash (Carbonate)**
Roessler & Hasslacher Chemical Co.

**Potassium Bi-fluoride**
Innis, Speiden & Co.
Roessler & Hasslacher Chemical Co.

**Pottery Machinery**
Mueller Machine Co., Inc.

**Pug Mills**
Chambers Brothers Co.
Mueller Machine Co., Inc.

**Pulverizing Machinery**
Abbé, Paul O.
Jeffrey Mfg. Co.
Mueller Machine Co., Inc.

**Pulverizing Mills**
Abbé, Paul O.
Jeffrey Mfg. Co.
Mueller Machine Co., Inc.

**Pumps**
Mueller Machine Co., Inc.

**Pump Governors**
Fisher Governor Co.

**Pumps (Oil)**
Maxon Premix Burner Co.

**Pyrometers (Indicating)**
Brown Instrument Co.
Engelhard, Chas., Inc.
Fisher Scientific Co.
Leeds & Northrup Co.

**Pyrometers (Optical)**
Fisher Scientific Co.

**Pyrometers (Recording)**
Brown Instrument Co.
Engelhard, Chas., Inc.
Leeds & Northrup Co.

**Pyrometer (Switches)**
Brown Instrument Co.
Engelhard, Chas., Inc.
Leeds & Northrup Co.

**Pyrometer Thermocouples**
Brown Instrument Co.
Engelhard, Chas., Inc.

**Pyrometer Tubes (Refractory and Hard Porcelain)**
Brown Instrument Co.
Corundite Refractories Co.
Engelhard, Chas., Inc.
Fisher Scientific Co.
Leeds & Northrup Co.
McDaniel Refractory Porcelain Co.
Montgomery Porcelain Products Co.

**Pyrometer Tubes (Silica)**
Fisher Scientific Co.

### R

**Recorders (CO, $CO_2$, $SO_2$ and Draft)**
Engelhard, Chas., Inc.

**Recording Instruments**
Brown Instrument Co.
Engelhard, Chas., Inc.
Fisher Scientific Co.
Leeds & Northrup Co.

**Reducing Valves**
Fisher Governor Co.

**Refractories**
Corundite Refractories Co.
The Carborundum Co.
The Exolon Co.
Harbison Walker Refractories Co.
Norton Co.
United Clay Mines Corp.

**Refractory Materials**
The Exolon Co.
Harbison Walker Refractories Co.
United Clay Mines Corp.

**Regulators (Automatic Temperature)**
Brown Instrument Co.
Engelhard, Chas., Inc.
Leeds & Northrup Co.

*(When writing to advertisers, please mention the JOURNAL)*

MAXON PREMIX BURNER

*Free!*

Either of the above bulletins will be gladly sent upon request. They illustrate and explain the Premix method of burning gas or oil for industrial purposes.

MAXON PREMIX BURNER CO.
2500 So. Mulberry St.
Muncie, Indiana

1816 CHEMICALS 1928

"Over a Century of Service and Progress"

South Dakota
FELDSPAR

An extremely high-grade Potash Spar ground in our own mills under constant and thorough chemical control.

Capacity up to 300 Tons Daily

We solicit your inquiries

INNIS, SPEIDEN & CO., Inc.
Importers, Manufacturers, Exporters
46 CLIFF STREET NEW YORK

Branches:
BOSTON PHILADELPHIA
CHICAGO CLEVELAND
GLOVERSVILLE

*We Have Been Producing High Grade Products for 63 Years*

Uniform Quality Feldspars

A most important factor for consumers of feldspar to consider is that they secure this product from a dependable source of large extent, thus insuring uniformity for a long period of time. The matter of continuity of deposits is essential in selecting and adopting feldspar. A mixture of spars from several different deposits of limited extent is not an assurance of uniformity.

*Let us tell you of our extensive deposits*

GOLDING SONS COMPANY
ERWIN FELDSPAR COMPANY
*"A Combination for Trade Service"*
Trenton, New Jersey

If you do not see advertised what you need, write us. That is part of our service to the Ceramic Industry.

AMERICAN CERAMIC SOCIETY
2525 N. High Street
COLUMBUS, OHIO

*(When writing to advertisers, please mention the JOURNAL)*

## BUYERS' GUIDE (continued)

### S

**Saggers**
The Carborundum Co.
Norton Co.
Potters Supply Co.

**Sagger Conveyors**
Jeffrey Mfg. Co.

**Sagger Clay (Georgia)**
Golding Sons Company

**Sagger Presses**
Chambers Brothers Co.
Mueller Machine Co., Inc.
Watson-Stillman Co.

**Screens**
Jeffrey Mfg. Co.
W. S. Tyler Co.

**Screens (Electric Vibrating)**
W. S. Tyler Co.

**Screens (Cloth)**
W. S. Tyler Co.

**Screening Machinery**
W. S. Tyler Co.

**Separators (Inclined Vibrating)**
W. S. Tyler Co.

**Selenite of Sodium**
Drakenfeld & Co., B. F.
Harshaw, Fuller & Goodwin Co.
Vitro Mfg. Co.

**Selenium**
Drakenfeld & Co., B. F.
Roessler & Hasslacher Chemical Co.

**Shakers (Testing Sieve)**
W. S. Tyler Co.

**Shovels (power)**
Jeffrey Mfg. Co.

**Sieves (Testing)**
W. S. Tyler Co.

**Silica (fused)**
The Exolon Co.

**Silica Blocks**
Eureka Flint & Spar Co.

**Silicon Carbide**
The Exolon Co.

**Silicon Carbide Firesand**
The Exolon Co.

**Sillimanite (Synthetic)**
The Exolon Co.
Norton Co.

**Slabs (Furnace)**
The Carborundum Co
Norton Co.

**Smelters**
Chicago Vitreous Enamel Product Co.
U. S. Smelting Furnace Co.

**Soda Ash**
Harshaw, Fuller & Goodwin Co.
Innis, Speiden & Co.
Roessler and Hasslacher Chemical Co.

**Sodium Antimonate**
Harshaw, Fuller & Goodwin Co.
Metal & Thermit Corp.
Vitro Mfg. Co.
Roessler and Hasslacher Chemical Co.

**Sodium Fluoride**
Harshaw, Fuller & Goodwin Co.
Innis, Speiden & Co.
Roessler and Hasslacher Chemical Co.

**Spar**
Harshaw, Fuller & Goodwin Co.
Pennsylvania Pulverizing Co.
Roessler and Hasslacher Chemical Co.

**Sprockets**
Jeffrey Mfg. Co.

**Spurs**
Potters Supply Co.

**Steam Traps**
Fisher Governor Co.

**Stilts**
Potters Supply Co.

**Strainers (Oil—Water)**
Fisher Governor Co.
Maxon Premix Burner Co.

**Sulphuric Acid**
Drakenfeld & Co., B. F.
Harshaw, Fuller & Goodwin Co.
Pennsylvania Salt Mfg. Co.
Roessler and Hasslacher Chemical Co.

### T

**Tachometers**
Brown Instrument Co.

**Talc**
Harshaw, Fuller & Goodwin Co.
Innis, Speiden & Co.
Roessler and Hasslacher Chemical Co.

**Temperature Controls**
Engelhard, Chas., Inc.

**Temperature Instruments (Measuring)**
Brown Instrument Co.
Engelhard, Chas., Inc.
Fisher Scientific Co.
Leeds & Northrup Co.

**Thermocouples**
Brown Instrument Co.
Engelhard, Chas., Inc.
Leeds & Northrup Co.

**Thermometers (Electric Resistance) (Indicating, etc.)**
Brown Instrument Co.
Engelhard, Chas., Inc.
Leeds & Northrup Co.

*(When writing to advertisers, please mention the JOURNAL)*

## BUYERS' GUIDE (Continued)

**Thermometers (Mercurial)**
Fisher Scientific Co.

**Thimbles (Filtering Extraction)**
Norton Co.

**Tile (Refractory)**
The Carborundum Co. *(Carbofrax)*
Harbison Walker Refractories Co.

**Tile Machinery (Floor and Wall)**
Mueller Machine Co., Inc.

**Tin Oxide**
Drakenfeld & Co., B. F.
Harshaw, Fuller & Goodwin Co.
Metal & Thermit Corp.
Roessler and Hasslacher Chemical Co.

**Titanium**
Titanium Alloy Mfg. Co.

**Transmission Machinery**
Jeffrey Mfg. Co.

**Tubes (Insulating)**
McDanel Refractory Porcelain Co.
Montgomery Porcelain Products Co.

**Tubes (Pyrometer)**
Brown Instrument Co.
Engelhard, Chas., Inc.
Fisher Scientific Co.
Leeds & Northrup Co.
McDanel Refractory Porcelain Co.
Montgomery Porcelain Products Co.

### U

**Unloaders, Car**
Jeffrey Mfg. Co.

### V

**Vacuum Pumps**
Fisher Scientific Co.
Mueller Machine Co., Inc.

**Valves (Automatic Control)**
Brown Instrument Co.
Engelhard, Chas., Inc.

**Valves (Reducing, Pressure, Exhaust)**
Fisher Governor Co.

**V-Notch Meters**
Brown Instrument Co.

**Vibrating Screens**
W. S. Tyler Co.

### W

**Wet Enamel**
Chicago Vitreous Enamel Product Co.
Vitro Mfg. Co.

**Whiting**
Drakenfeld & Co., B. F.
Harshaw, Fuller & Goodwin Co.
Innis, Speiden & Co.
Roessler and Hasslacher Chemical Co.

**Wire Cloth**
W. S. Tyler Co.

**Witherite**
Harshaw, Fuller & Goodwin Co.
Innis, Speiden & Co.

**Woven Wire**
W. S. Tyler Co.

### Z

**Zirconia**
Roessler and Hasslacher Chemical Co.
Titanium Alloy Mfg. Co.
Vitro Mfg. Co.

**Spend Your MATERIAL DOLLAR**
**Where You Sell YOUR WARE**
**BUY AMERICAN BALL CLAY**
**H. C. SPINKS CLAY CO. Newport, Ky.**

# ALPHABETICAL LIST OF ADVERTISERS


| | Page |
|---|---|
| Abbé, Paul O. | 33 |
| American Gas Association | 4B |
| American Potash and Chemical Corp. | 18 |
| American Rolling Mill Co. | 2 |
| Brown Instrument Co. | 6 |
| Carborundum Co. | 3 |
| Chambers Brothers Co. | 34 |
| Chicago Vitreous Enamel Product Co. | 35 |
| Classified Advertising | 30 |
| Corundite Refractories Inc. | 32 |
| Drakenfeld and Co., B. F., Inc. | 22 |
| Edgar Brothers Co. | 18 |
| Engelhard, Chas., Inc. | 4 |
| Erwin Feldspar Co. | 26 |
| Eureka Flint & Spar Co. | 34 |
| Exolon Company | 24 |
| Ferro Enamel Supply Co. | 18 |
| Fisher Governor Co. | 5 |
| Fisher Scientific Co. | 12 |
| General Electric Co. | 37 |
| Golding Sons Co. | 26 |
| Genesee Feldspar Co. | 35 |
| Harbison-Walker Refractories Co. | 33 |
| Harshaw, Fuller and Goodwin Co. | 8 |
| Innis, Speiden & Co., Inc. | 26 |
| Journal of the Society of Glass Technology | 20 |
| Kentucky-Tennessee Clay Co. | 33 |
| Lake County Clay Co. | 18 |
| LaMotte Chemical Products Co. | 35 |
| Leeds and Northrup Co. | 1 |
| Maxon Premix Burner Co. | 26 |
| McDanel Refractory Porcelain Co. | 20 |
| Metal & Thermit Corp. | Outside Back Cover |
| Montgomery Porcelain Products Co. | 34 |
| Mueller Machine Co. | 20 |
| National Silica Co. | 16 |
| Norton Co. | 14 |
| Old Hickory Clay & Talc Co. | 35 |
| Pacific Coast Borax Co. | 24 |
| Pennsylvania Pulverizing Co. | 36 |
| Pennsylvania Salt Mfg. Co. | 18 |
| Philadelphia Drying Machinery Co. | 38 |
| Potters Supply Company | 16 |
| Proctor and Schwartz, Inc. | 31 |
| Professional Directory | 30 |
| River Feldspar Co. | 24 |
| Roessler and Hasslacher Chemical Co. | Inside Front Cover |
| Spinks, H. C. Clay Co. | 28 |
| Titanium Alloy Mfg. Co. | Center of Book 10 |
| Tyler, W. S., Co. | Center of Book 9 |
| United Clay Mines Corp. | 33 |
| U. S. Smelting Furnace Co. | 11 |
| Vitro Manufacturing Co. | 36 |


*(When writing to advertisers, please mention the JOURNAL)*

## CLASSIFIED ADVERTISING

WANTED: *Ceramic Engineer.* Experienced in the manufacture of roofing tile, and capable of making a field survey of available clays and report on molding, drying and burning behavior. Three to six months employment assured, with possibility of position as plant superintendent, if general conditions warrant. Position with well established firm in California planning enlargement of its activities. State age, technical training and types of tile with which familiar. Box 50-B, American Ceramic Society, 2525 N. High St., Columbus, Ohio.

Ceramic engineer with five years' experience in refractories, plant construction and operation, desires position with a progressive organization. Capable of taking full charge of production and produce results. Write full details to BOX 51-B, American Ceramic Society, 2515 N. High Street, Columbus, Ohio.

WANTED: Thoroughly experienced high grade vitreous enameler. Taking full charge of an 8-furnace department on cast iron and sheet metal. State full particulars in first letter. Address Box 39-B, American Ceramic Society, 2525 N. High Street, Columbus, Ohio.

Ceramist, specialized in art: First class man, for many years technical and art director of premier European enterprises, active in creating figured and ornamental ware, well grounded in designing new forms of ware and all sorts of services. 34 years old. Czechoslovakian. Staatsburg State Technical School education and Art Academy of Vienna. Conversant with all phases of manufacture, especially model arrangement, shape turning and retouching. Personally able to teach successfully. Seeking opportunity for employment in U.S.A. to prove my worth. Direct letters to

Wilhelm Thomasch
Krisch Kunstkeramiker,
Vienna XVIII
Antonigasse 62/III,
Austria

Enameler, thoroughly experienced on high grade quality stove parts (cast or sheet iron), reflectors, signs, refrigerator linings and boxes, executive ability and knowledge to increase production and keep operation and making of enamels under control, especially on job work, desires position where a responsible man is required. Available June 1. Box 49-B, American Ceramic Society, 2525 N. High Street, Columbus, Ohio.

## PROFESSIONAL DIRECTORY

**THE SHARP-SCHURTZ CO.**
**Chemists for the Ceramic Industry**
**We have fully equipped laboratories at Lancaster, Ohio, U. S. A.**

**T. W. GARVE**
***Engineering***
**510 Schultz Bldg., Columbus, Ohio**

**Remodeling and Design of Plants**
**Design of Buildings, Machinery, Dryers, and Kilns**
**Preliminary Investigations**

"Proctor"

# DRYING MACHINERY

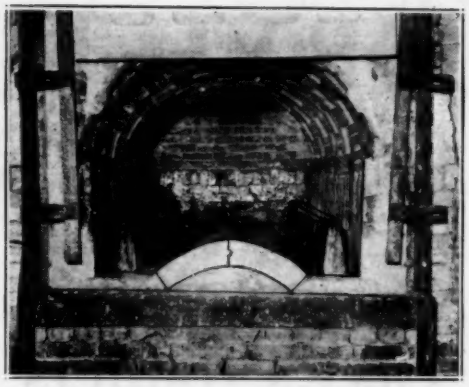
## for all Clay Products

Electrical Porcelain
Sanitary Ware
General Ware in Molds
Dipped General Ware
Clay Rolls : Spark Plugs
Saggers : Tile
Refractories : Brick
Chemical Stoneware

PROCTOR & SCHWARTZ, INC.
PHILADELPHIA, PA.

# Four Years . . . .

## *and still going strong!*



*The Muffle shown here was built entirely of CORUNDITE Muffle tile. The furnace in which it was installed has been in constant operation for four solid years. Records like this are demonstrating the greater economy of CORUNDITE installations.*

***Question:*** **Why did the sales of CORUNDITE High-Aluminous Muffles Increase 48.4% during 1927?**

***Answer:*** **Because users have discovered through experience that CORUNDITE muffles are standing up longer, that they are of higher quality and that they are more dependable.**

***We build muffles of all sizes and feature the famous Manion "V" Bottom. Likewise we supply either flat or arched bottom jobs.***

**Corundite Refractories, Inc.**

***Massillon, Ohio***

H. W. R. SAGGER CLAY
and
H. W. R. —D— CLAY

*For Your Complete Sagger Batch*

*Write for Complete Information*

**HARBISON-WALKER REFRACTORIES CO.**
World's Largest Producers of Refractories
**Pittsburgh, Pa., U.S.A.**

*Offices in Principal Cities*

KENTUCKY-TENNESSEE CLAY CO.

*Successors to*

KENTUCKY CONSTRUCTION & IMPROVEMENT CO.
THE MANDLE-PORTER CLAY CO.

*Miners and Shippers of High Grade Clays*

*General Office* - - MAYFIELD, KY.

HIGH GRADE
CLAYS
OF EVERY KIND - FOR EVERY PURPOSE
UNITED CLAY MINES
CORPORATION
GENERAL OFFICES TRENTON, N. J.

PAUL O. ABBÉ

Ball and Pebble Grinding Mills and Mixers

PAUL O. ABBÉ INC.

247 Center Ave.
Little Falls, New Jersey

If you want pyrometer protection tube satisfaction, use

**MONTGOMERY PYROMETER TUBES**

All Sizes and Lengths for either Platinum or Base Metal Couples

The Best Liked and Most Largely Used
Protection Tubes on the Market today

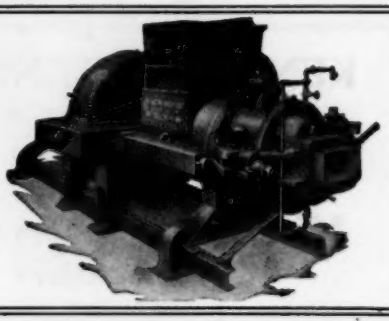
If the manufacturer of your pyrometer equipment cannot supply you, write us direct.

TRADE MARK

MONTGOMERY PORCELAIN PRODUCTS CO.
FRANKLIN, OHIO, U. S. A. 10-22

**Brick Making Machines**

Crushers Grinders Mixers
Automatic Cutters



**Chambers Bros. Co.**
Philadelphia Pennsylvania

**EUREKA**
FLINT & SPAR Co.

**MINERS, IMPORTERS AND PULVERIZERS**

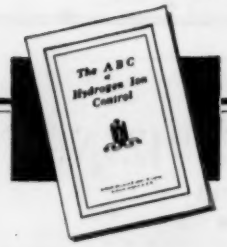
Pure English Cornwall Stone

| | |
|---|---|
| Imported French Flint | Eureka #1 Feldspar |
| French Placing Flint | Connecticut Feldspar |
| American Rock Flint | New Hampshire Feldspar |
| American Sand Flint | New York Feldspar |

*Eureka Specially Selected Glaze Spar has been famous for Twenty Years for its Brilliant Lustre*

**EUREKA FLINT & SPAR CO.**
*Trenton – New Jersey*

*(When writing to advertisers, please mention the JOURNAL)*




## ACCEPT THIS BOOK
### *With Our Compliments*

Here is the story of Hydrogen Ion Control, told in simple language and including a special chapter on its application to the ceramic industry.

We will gladly send a complimentary copy on request. Write for yours today.

**LaMotte Chemical Products Co.**
***414 Light St., Baltimore, Md.***

## LUSTERLITE
Quality Products for the Enameling Industry

Rainbow Radiance brought to Earth. Enamels and Color Oxides. Ask about the Lusterlite service of ceramic experts who will assist you gratis.

Furnaces, Speed Forks. Complete Enamel Shop. Supplies and Equipment. Ask to be placed on our mailing list and receive the LUSTERLITE LEADER monthly.

**Chicago Vitreous Enamel Product Co.**
***Cicero, Illinois***

## High Grade Clays

**Ball Clay**—For "Ivory body," Electrical and High Tension porcelain, Floor & Wall Tile, Glaze mixes, Refractories, Chemical Stoneware, Abrasives, etc.

**Sagger Clay**—Good plasticity and strength, fairly high silica content, Low shrinkage—makes sagger stand up straight and strong in green state—practically no dunting or cracking in drying.

**Large Storage Sheds**—Clays shipped either crushed or in lump. Let us send you samples and quotations.

**Old Hickory Clay & Talc Company**
**Paducah, Kentucky**

**Largest Independent Mine in the district**
**1918 1928**

## Genesee Feldspar
**Highest Grade Canadian Feldspar**
**Uniform Quality-Unlimited Quantity**
***Dependable!***

## *Announcement*

We wish to announce to our customers and the ceramic trade in general that we have just closed negotiations for the Famous RICHARDSON MINE, which, in conjunction with our other holdings, insure an unlimited supply of the Highest Grade Canadian Potash Feldspar.

Users of Genesee Feldspar can, therefore, feel sure of Increased Profit through receiving a Uniform Quality of the Highest Grade Canadian Feldspar *at all times.*

*Send For Test Samples*

**GENESEE FELDSPAR CO., INC.**
**Rochester, New York**

# PENNSYLVANIA PULVERIZING CO.

**LEWISTOWN, PA.**

**Pure Canadian Potash Feldspar**
**Potters Flint  Placing Sand**

**SALES OFFICE**
**323 Fourth Avenue**
**Pittsburgh, Pa.**

THE VITRO MFG. CO. TRADE MARK PITTSBURG, PA.

## *Laboratory Control Guarantees Uniformity*

Every step in the manufacture of Vitro Products is under direct and constant laboratory control. This gives you products of absolute uniformity and complete freedom from undesirable impurities. Vitro Products give Specified Results.

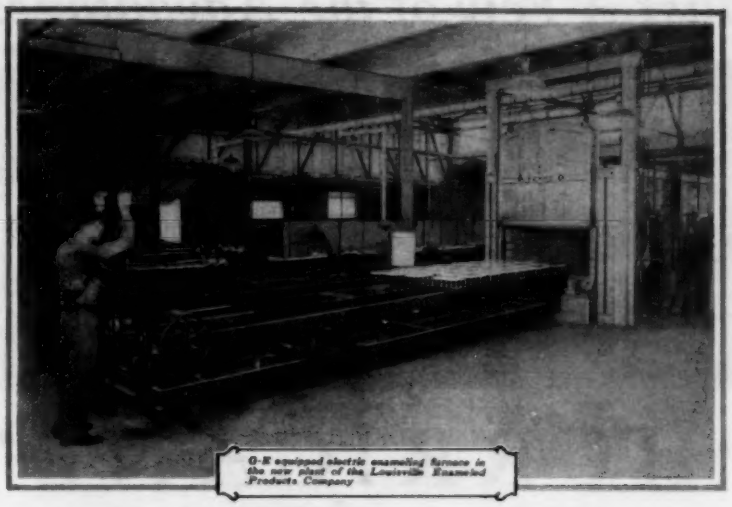
*Write for prices and full information.*

**Products of Vitro Manufacturing Co.**

**Vitrifiable Colors**
**Chromium Oxide**
**Cadmium Sulphide**
**Selenium**
**Sodium Uranyl Carbonate**
**Sodium Uranate**
**Sodium Antimonate**
**Copper Oxide**
**Zirconium Products**
**Cobalt Oxide**
**Cement Colors**
**Roman Gold**
**White Gold**
**Enamels for Cast Iron**
**Enamels for Sheet Steel**
**Porcelain Sanitary Enamels**
**Copper Enamels**

**THE VITRO MANUFACTURING CO.**
**Fulton Bldg., PITTSBURGH, PA.**

*(When writing to advertisers, please mention the JOURNAL)*



G-E equipped electric enameling furnace in the new plant of the Louisville Enameled Products Company

# A Practical Enameler's Experience with Electric Heat

"In spite of the uneven thickness of our castings—varying from 3 in. to less than 1/2 in.—we are getting these pieces through in our regular line of production. We are burning large sheet-iron cylinders of 30 in. diameter and also half-cylinders with no warping trouble. We do not turn the furnace on until seven o'clock Monday morning, and at 7:25 we are ready to start the day's production. We are burning entirely up to the door."

L. B. Hart, Supt.
Louisville Enameled Products Co.

Although electric heat will not supplant all other forms of heat for industrial purposes, there are processes in every industry where it is the ideal heat—the most economical heat—the heat that ultimately will be used.

ULTIMATELY ELECTRIC HEAT IN EVERY INDUSTRY

G-E equipped electric enameling furnaces pay for themselves quickly—then return large dividends. They permit remarkable production speeds, cut down the rejections, make working conditions more comfortable—and save as much as one thousand dollars a year in maintenance cost alone.

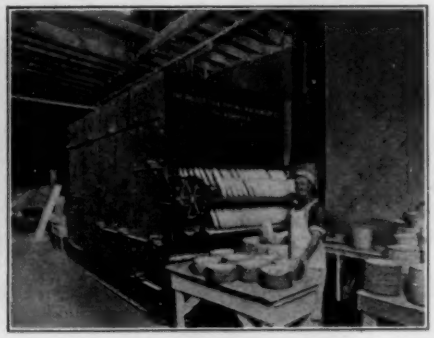
Call up your nearest G-E office and talk over your next enameling furnace with the G-E heating specialist.

570-60 D

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES

## *Just A Few of the Advantages*



# "HURRICANE"

## Automatic Stove Rooms

**Uniform Drying.** Efficient recirculation of warm air dries all parts of every piece thoroughly and at the same speed. Losses are thus greatly reduced.

**Elimination of Rehandling.** The molds need not be removed from the endless conveyor which carries them back to the jiggerman. Conveyor speed can be regulated according to his ability.

**Fewer Molds Required.** The life of the molds is lengthened and their number can be reduced by one-quarter or one-half.

## Automatic Mangles

**Saving of Time.** Rapid recirculation and even distribution of warm air quickly prepares dipped ware for the kiln.

**Floor Space Economized.** Ware can be stacked in piles ready for the kiln man, as soon as dry. The mangle itself requires but little room.

**Scars, etc., Eliminated.** Cut marks, finger prints and other blemishes, caused by the frequent rehandling in other methods, are avoided.

**"HURRICANE" MACHINES** can be fitted with Automatic Humidity Control to meet special drying requirements. "HURRICANE" Dryers are also made in Truck, Tunnel Truck and Tray types—for spark plugs, tile, electrical insulators, saggers, etc.

## The Philadelphia Drying Machinery Co.

HURRICANE
*Ideal Drying Every Day*

**3351 Stokley Street**
**Philadelphia, Pa.**

***New England Office:*** **53 State St., Boston, Mass.**

97

Back in 1921-22, the Society presented to the ceramic industry through its Committee on Standards, the yearly report of that Committee. There has been progress made along the lines of testing and standardization in that new methods, apparatus, machinery, etc., have been developed. Visioning the greater benefits to the industry, the SOCIETY is planning on presenting in the June issue of the *Journal*, all the latest specifications, both tentative and standard, that have been found worth while and of value to the ceramic industry.

The June issue is not to be a special issue. It is simply the usual *Journal* but with the added feature of the report of the Committee on Standards included therein. The demand for the 1921-22 report still continues but as the 1928 report will supersede it, who can tell what distribution it will have. Regardless of your product, it should be advertised in this issue because of the publicity you will receive from fields other than the ceramic field. Final advertising copy is due on May fifteenth for this issue of the *Journal*.

AMERICAN CERAMIC SOCIETY
2525 N. HIGH ST. COLUMBUS, OHIO

# BEST AT ANY PRICE

Each month we are gaining new customers for our tin oxide—and they keep on buying. Evidently these firms are finding that the best opacifier at any price is—

**M and T**

## TIN OXIDE

*A good article sold at a fair price will find an ever widening market.*

SAMPLES CHEERFULLY FURNISHED

## METAL & THERMIT CORPORATION

*Ceramic Department*

Homer F. Staley, *Mgr.*
R. R. Danielson, *Dir. of Research*

120 Broadway, NEW YORK CITY